Grade 5 Mini-Assessment – "Looking for Lunar Ice"

Today you will read a passage about scientists' search for water on the Moon. You will then answer several questions based on the text. I will be happy to answer questions about the directions, but I will not help you with the answers to any questions. You will notice as you answer the questions that some of the questions have two parts. You should answer Part A of the question before you answer Part B, but you may go back and change your answer to Part A if you want to.

Take as long as you need to read and answer the questions. If you do not finish when class ends, come see me to discuss the ways you may have additional time.

Now read the passage and answer the questions. I encourage you to write notes in the margin as you read the passage.

Looking for Lunar Ice

from *Far-Out Guide to the Moon* by Mary Kay Carson

1 Lunar rocks lost their water long ago. So the Moon is a totally dry world, right? Not necessarily. Remember that the Moon is covered in impact craters. Many of those impacting comets, asteroids, and meteoroids delivered some water ice to the Moon. The ice carried by space rocks scattered across the lunar surface upon impact. Sunlight quickly evaporated most of the ice. But scientists suspect that some of that water ice still survives on the Moon.

2 "The only way water can be preserved on the Moon…is in extremely cold areas," explains lunar scientist Alan Binder. The coldest places on the Moon are where the Sun never shines. Some of the Moon's deep craters cast permanent shadows. The Moon's north and south poles have some always-dark craters. How much ice survives in these "cold trap" craters? Scientists are working to find out. Finding a lot of ice on the Moon would be a big deal. If humans are going to build a moon base someday, they will need water. Not having to bring water from Earth would be a big help.

SEARCHING THE SHADOWS

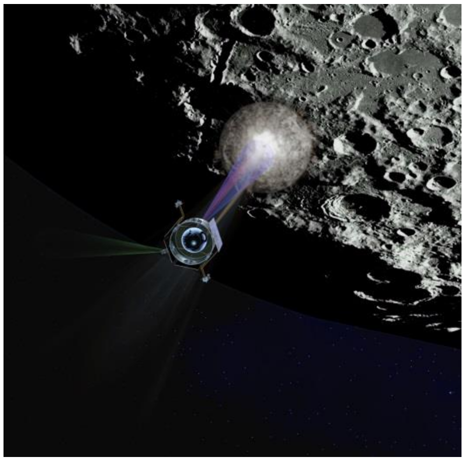
3 Two decades passed without a single lunar visitor after the last astronaut walked on the Moon in 1972. Another spacecraft finally headed to our orbiting neighbor in 1994. No humans were aboard *Clementine* when it launched. It was a robotic space probe. *Clementine* mapped the Moon's surface. It found permanently dark craters near the Moon's poles. *Clementine's* radar also found hints of ice in those craters. But when radar telescopes on Earth looked, they could not find the lunar ice. So was it really there?

4 *Lunar Prospector* went to find out in 1998. The small space probe scanned the Moon's surface. Seven weeks after orbiting, *Lunar Prospector* scientists made a big announcement. "We have found water at both lunar poles," Alan Binder told reporters in March of 1998. He was in charge of the *Lunar Prospector* mission. Water ice crystals seemed to be mixed in with the dusty lunar soil. *Lunar Prospector* scientists said that a small lake's worth of water lay scattered as frost near the Moon's poles.

5 How could scientists be sure this time? They sacrificed their spacecraft to find out. In July of 1999, engineers sent *Lunar Prospector* crashing into a dark crater at the Moon's south pole. Scientists figured that the crash's dust cloud would have some water vapor in it. But no water showed up. The mystery of water of the Moon would take another ten years to solve.

MORE THAN EXPECTED

6 When the robotic explorer *Lunar Reconnaissance Orbiter* flew to the Moon in 2009, another spacecraft piggybacked on it. The *Lunar Crater Observation and Sensing Satellite (LCROSS)* aimed to finally answer whether or not there is ice on the Moon. Soon after launch, *LCROSS* separated from its ride and headed for crater Cabeus near the Moon's south pole. First *LCROSS* sent its booster rocket crashing into the crater. The spacecraft quickly radioed back what it saw in the debris cloud. Only minutes later *LCROSS* slammed itself into the crater, too, as astronomers on Earth searched the kicked-up cloud for water—and found it.



This illustration shows the *LCROSS* studying the debris plume from its crashed rocket booster.

(Courtesy of NASA)

7 “Yes, we found water,” *LCROSS* scientist Anthony Colaprete told reporters during the big announcement in late 2009. “And we didn’t find just a little bit.” They’d found enough water to fill a dozen two-gallon buckets. There’s likely a lot of ice on the Moon.

8 While *LCROSS* solved the Moon’s water mystery, it created another one. Scientists haven’t been able to identify some of the materials kicked-up into the debris cloud—yet. Scientists hope to find out what else might be hiding in them.

“Looking for Lunar Ice” from *Far-Out Guide to the Moon* by Mary Kay Carson; pgs 29-35 (text only); ©2011 by Mary Kay Carson; ISBN 978-0-7660-3189

QUESTIONS

1. **The following item has two parts. Answer Part A and then answer Part B.**

   Part A: What is the best definition of the word <u>impact</u> as it is used in the paragraph 1 of the article?

   A. dangerous force

   B. hard smash

   C. sudden change

   D. falling motion

   Part B: What are two ways that the word <u>impact</u> helps develop important ideas in the article?

   A. It shows that space is full of different types of debris.

   B. It proves that the moon is made of soft material.

   C. It explains how the moon's deep craters were formed.

   D. It explains why there is little water on the moon's surface.

   E. It tells how water was carried to the moon.

   F. It tells how the moon is affected by the sun.

2. **Based on the article, what were the <u>two</u> strongest reasons for investigating whether there is water on the moon?**

   A. to study how water differs from place to place

   B. to solve an interesting mystery

   C. to better understand how craters form

   D. to prepare for the possibility of a base

   E. to find new water sources for people on Earth

   F. to test out the latest space probes

3. **The following item has two parts. Answer Part A and then answer Part B.**

Part A: Why did scientists make the *Lunar Prospector* crash into a crater?

A. They wanted to dispose of the probe because it was no longer useful.

B. They wanted to know exactly how deep the crater was.

C. They wanted to see if it could locate the *Clementine* in the crater.

D. They wanted to create a dust cloud they could study.

Part B: In what way did the crash of the *Lunar Prospector* cause a problem for the scientists?

A. It made them think there was no water on the moon after all.

B. It resulted in the loss of a valuable spacecraft.

C. It revealed materials they did not recognize.

D. It made conditions on the moon bad for future probes.

4. **How is the main idea in the first two paragraphs of the article related to the main idea in the rest of the article?**

A. The first two paragraphs give reasons there could be water ice on the moon, and the rest of the article explains how scientists have explored this possibility.

B. The first two paragraphs describe which parts of the moon are the coldest, and the rest of the article explains how scientists have gathered data about temperatures on the moon.

C. The first two paragraphs show how water on the moon could help people, and the rest of the article explains why LCROSS was sent into space to help gather information about ice on the moon.

D. The first two paragraphs describe the problem scientists face in trying to collect information about the moon, and the rest of the article lists solutions that have helped overcome this problem.

5. **Each of the spacecraft in the chart below had a role in helping scientists determine whether or not there is water on the moon. From the list of contributions below, select the most important way that each of these four crafts provided support for the exploration of the moon. Write each of your choices in the proper place on the chart.**

Spacecraft **Biggest Contribution**

Spacecraft	Biggest Contribution
Clementine	
Lunar Prospector	
Lunar Reconnaissance Orbiter	
LCROSS	

List of Contributions

- **found ice crystals in soil near poles**
- **scanned moon's surface**
- **revealed water by crashing into crater**
- **sent booster rocket into crater**
- **found hints of ice in dark craters**
- **mapped moon's surface**
- **carried craft designed to solve water mystery**

6. Based on the article, what are <u>two</u> things we still do not know about the moon?

A. Whether there is water anywhere but the poles

B. Whether ice on the moon can melt

C. Why certain craters are so cold and deep

D. How much water is on the moon

E. What some of the materials at the bottom of craters are

F. How lunar rocks became scattered across the moon

7. The following question has two parts. Answer Part A and then answer Part B.

Part A: Why did scientists choose the crater Cabeus as the site to crash the LCROSS and its booster rocket?

A. The crater is an impact crater near the Moon's south pole, where more water ice is likely to have been scattered.

B. The inside of the crater is always dark, making it cold enough to keep water ice from evaporating.

C. The crater is one of the smaller ones on the Moon, where less evaporation of the water ice takes place.

D. The outside of the crater is not in complete darkness, making it easier for scientists to see the water ice.

Part B: Which detail from the first two paragraphs of the article <u>best</u> supports the response to Part A?

A. "Remember that the Moon is covered in impact craters. Many of those impacting comets, asteroids, and meteoroids delivered some water ice to the Moon. "

B. "The ice carried by space rocks scattered across the lunar surface upon impact. Sunlight quickly evaporated most of the ice."

C. "But scientists suspect that some of that water ice still survives on the Moon."

D. "The coldest places on the Moon are where the Sun never shines. Some of the Moon's deep craters cast permanent shadows."

8. (Optional writing prompt): Explain how scientists finally answered the question of whether or not there is water on the moon. Describe how the idea first came to the attention of scientists, how it was supported or challenged by evidence, and what scientists believe now. Be sure to use details from the article to support your response. Write your response using the lines on the next page.

Your response will be scored on how well you:

- **Demonstrate your understanding of the ideas of the text**
- **Use evidence from the text to help develop and support your ideas**
- **Organize your response in a logical manner**
- **Demonstrate an appropriate writing style through the use of precise word choice and varied sentences**
- **Use standard conventions for writing**

Information for Teachers: Quantitative and Qualitative Analyses of the Text

Regular practice with complex texts is necessary to prepare students for college and career readiness. The excerpt for this mini-assessment is placed at grade 5 for the purpose of this exemplar. This section of the exemplar explains the process that was used to place the text at grade 5 and the reasons that it meets the expectations for text complexity in Reading Standard 10. "Appendix A of the Common Core" and the "Supplement to Appendix A: New Research on Text Complexity" lay out a research-based process for selecting complex texts.

1. Place a text or excerpt within a **grade band** based on at least one[1] quantitative measure according to the research-based conversion table provided in the "Supplement to Appendix A: New Research on Text Complexity" (www.corestandards.org/resources).

2. Place a text or excerpt at a **grade level** based on a qualitative analysis.

"Looking for Lunar Ice"	**Quantitative Measure #1**	**Quantitative Measure #2**
	Lexile: 860	Flesch-Kinkaid: 6.1

After gathering the quantitative measures, the next step is to place the quantitative scores in the Conversion Table found in the "Supplement to Appendix A" (www.corestandards.org/resources) and determine the **grade band** of the text. **NOTE: With scientific texts, there are often many scientific terms that drive the readability ratings up. Careful attention should be paid to the complexity of the topic itself in these cases so that the scientific terms don't force the passage into a grade level that is too high for the concept.** Figure 1 reproduces the conversion table from the Supplement to Appendix A, showing how the initial results from Flesch-Kinkaid and the Lexile measure were converted to grade bands.

Figure 1: Updated Text Complexity Grade Bands and Associated Ranges from Multiple Measures[7]

Common Core Band	ATOS	Degrees of Reading Power®	Flesch-Kincaid[8]	The Lexile Framework®	Reading Maturity	SourceRater
2nd – 3rd	2.75 – 5.14	42 – 54	1.98 – 5.34	420 – 820	3.53 – 6.13	0.05 – 2.48
4th – 5th	4.97 – 7.03	52 – 60	4.51 – 7.73	740 – 1010	5.42 – 7.92	0.84 – 5.75
6th – 8th	7.00 – 9.98	57 – 67	6.51 – 10.34	925 – 1185	7.04 – 9.57	4.11 – 10.66
9th – 10th	9.67 – 12.01	62 – 72	8.32 – 12.12	1050 – 1335	8.41 – 10.81	9.02 – 13.93
11th – CCR	11.20 – 14.10	67 – 74	10.34 – 14.2	1185 – 1385	9.57 – 12.00	12.30 – 14.50

[1] For higher stakes tests, it is recommended that two corresponding text complexity measures be used to place a text in a grade band. When two measures are used, both placing the text in the same **band**, the results provide additional assurance that the text selected is appropriate for the band.

To find the **grade level** of the text within the designated grade band, engage in a systematic analysis of the characteristics of the text. The characteristics that should be analyzed by doing a qualitative analysis are included below and discussed fully in Appendix A of the CCSS. (www.corestandards.org).

Qualitative Analysis	**"Looking for Lunar Ice"**	**Where to place within the band?**					
Category	**Notes and comments on text, support for placement in this band**	Too Low	Early – mid 4	Mid – end 4	Early – mid 5	End 5	**NOT suited to band**
Structure: (both story structure or form of piece)	This excerpt is organized in an accessible manner. The author presents a problem (an unsolved mystery) and then describes the ways NASA set out to find answers. The details about how NASA conducted its fact finding are provided in chronological order, guiding readers through the various lunar missions. The conclusion introduces a secondary mystery, leaving readers wondering about how much water is on the moon. Subheadings should help enhance the reader's understanding of content, and a supplementary illustration directly supports the text. Together, these aspects of the structure help make the text accessible at grade 5.						
Language Clarity and Conventions	The language conventions in the text are explicit and straightforward. The excerpt includes simple and compound sentences, mixed with a number of more complex constructions (e.g., *When the robotic explorer Lunar Reconnaissance Orbiter flew to the Moon in 2009, another spacecraft piggybacked on it.).* Vocabulary is mostly contemporary and familiar. There are instances of tier 3 words that may be unfamiliar to students (*asteroids, meteoroids, orbiting*); however, there is sufficient context for readers to grasp the meaning of the subject-specific vocabulary.						
Knowledge Demands (life, content, cultural/literary)	To understand the text, it would be helpful for students to have a basic understanding of space exploration and the Moon's environment. But even without that knowledge, the information needed to answer the test questions lies within the four corners of the text.						
Levels of Meaning (chiefly literary)/ Purpose (chiefly informational)	The main purpose of the text is implicit but readily accessible: After many years and several lunar explorations investigating the presence of lunar ice, scientists confirmed that water is present on the Moon. Their next mystery is also presented: How much water is there?						
Overall placement: Grade 5	**Justification: This text is moderately complex in regard to sentence structure, vocabulary, and knowledge demands. The domain-specific vocabulary may be challenging, but is still likely to be accessible to the average 5th grader. This mini-assessment may be most appropriate for advanced 5th graders early in the year or all 5th graders later in the year.**						

Question Annotations: Correct Answer(s) and Distractor Rationales

Question Number	Correct Answer(s)	Standards	Rationales for Answer Options
1 Part A	**B**	**RI.5.4, RI.5.1**	A. Although an impact might serve as a "dangerous force," in paragraph 1 the word "impact" is used to show that an object smashed forcefully into the moon. B. This is the correct answer. "Hard smash" refers to the force with which the space rocks land. C. "Sudden change" refers to how quickly the space rocks affected the lunar surface rather than the force of their landing. D. "Falling motion" refers to how the space rocks moved rather than the force of their landing.
1 Part B	**C, E**		A. The word "impact" helps develop how space rocks affected the moon, rather than what other types of debris exist in space. B. The word "impact" suggests that space rocks changed the surface of the moon because of their great force, not because of the composition of the moon. C. This is a correct answer. The powerful force of the space rocks hitting the surface of the moon caused deep craters to form. D. The amount of water on the lunar surface is dependent on factors other than the force of space rocks hitting the moon. E. This is a correct answer. The space rocks that impacted the surface of the moon delivered water to the moon. F. "Impact" focuses on the effect of space rocks on the moon, not the effect of the sun on the moon.

Question Number	Correct Answer(s)	Standards	Rationales for Answer Options
2	**B, D**	**RI.5.3, RI.5.1**	A. Although scientists were interested in learning about water on the moon, their purpose was not to compare water from multiple places. B. This is a correct answer. Scientists wanted to determine the truth about water on the moon after receiving conflicting information from different space missions. C. Although space rocks formed craters, scientists were interested in the water brought by the rocks, not the formation of the craters. D. This is a correct answer. In paragraph 2, the author states, “Not having to bring water from Earth would be a big help” to building a moon base. E. Although the author states that people will need water, the reference is to people living on a moon base, rather than people inhabiting Earth. F. Although the space probes were developed specifically to investigate water on the moon, they would not have been developed if there had not been a mystery or problem to solve.
3 Part A	**D**	**RI.5.2, RI.5.1**	A. Although the *Lunar Prospector* was unusable after its mission, scientists purposefully crashed it to create a dust cloud, not to dispose of the craft. B. Although scientists crashed the *Lunar Prospector* into a crater, the purpose of the probe was to scan the moon’s surface, not measure crater depth. C. Although the *Clementine* probe went to the moon before the *Lunar Prospector*, there is no evidence to suggest that the *Clementine* was in the crater. D. This is the correct answer. Paragraph 5 states, “engineers sent *Lunar Prospector* crashing into a dark crater at the Moon’s south pole” and “Scientists figured that the crash’s dust cloud would have some water vapor in it.”
3 Part B	**A**		A. This is the correct answer. According to paragraph 5, “Scientists figured that the crash’s dust cloud would have some water vapor in it. But no water showed up.” B. Although their plan would ruin the probe, engineers purposefully crashed the *Lunar Prospector*. C. The *LCROSS* crash, not the *Lunar Prospector,* revealed substances scientists could not identify. D. The article does not suggest that the *Lunar Prospector* crash changed moon conditions for future probes.

<table>
<tr><th>Question Number</th><th>Correct Answer(s)</th><th>Standards</th><th colspan="3">Rationales for Answer Options</th></tr>
<tr><td>4</td><td>A</td><td>RI.5.2, RI.5.1</td><td colspan="3">A. This is the correct answer. Paragraphs 1 and 2 explain how and where water is on the moon, while the rest of the article describes space explorations that studied water on the moon.
B. Although paragraph 2 identifies which parts of the moon are coldest, this is a minor detail supporting the main idea that there may be water present on the moon.
C. Although paragraph 2 explains a benefit of finding water on the moon, this is a minor detail supporting the main idea of why scientists have explored this possibility.
D. Although it is clear that collecting information about the moon is not easy, the focus of the article is not the difficulty of collecting information but the question of whether or not there is water ice on the moon.</td></tr>
<tr><td rowspan="4">5</td><td rowspan="4">See answers and rationales in right-hand column.</td><td rowspan="4">RI.5.2, RI.5.3, RI.5.1</td><td>Clementine</td><td>Answer:
found hints of ice in dark craters</td><td>Rationale: According to paragraph 3, “Clementine’s radar also found hints of ice in those craters.”</td></tr>
<tr><td>Lunar Prospector</td><td>Answer:
found ice crystals in soil near poles</td><td>Rationale: According to paragraph 4, “Water ice crystals seemed to be mixed in with the dusty lunar soil.”</td></tr>
<tr><td>Lunar Reconnaissance Orbiter</td><td>Answer:
carried craft designed to solve water mystery</td><td>Rationale: According to paragraph 6, “When the robotic explorer Lunar Reconnaissance Orbiter flew to the Moon in 2009, another spacecraft piggybacked on it.”</td></tr>
<tr><td>LCROSS</td><td>Answer:
revealed water by crashing into crater</td><td>Rationale: According to paragraph 6, “Only minutes later LCROSS slammed itself into the crater, too, as astronomers on Earth searched the kicked-up cloud for water—and found it.”</td></tr>
</table>

Question Number	Correct Answer(s)	Standards	Rationales for Answer Options
6	**D, E**	**RI.5.8, RI.5.1**	A. According to paragraph 2, water could be found only on the coldest parts of the moon, the poles, so we know there cannot be water elsewhere on the moon. B. According to paragraph 1, “Sunlight evaporated most of the ice” brought to the moon by space rocks. To be evaporated, the ice would need to melt first. C. According to paragraph 2, “The coldest places on the Moon are where the Sun never shines” because of the depth of the craters, so we know why certain craters are cold and deep. D. This is a correct answer. According to paragraph 7, “There’s likely a lot of ice on the Moon,” but based on the findings of so far of “a dozen two-gallon buckets” of water, we do not know for sure. E. This is a correct answer. According to paragraph 8, “Scientists haven’t been able to identify some of the materials kicked-up into the debris cloud—yet.” F. According to paragraph 1, “The ice carried by space rocks scattered across the lunar surface upon impact,” so we know how rocks were scattered across the moon.
7 Part A	**B**	**RI.5.3, RI.5.1**	A. Although the Cabeus is near the Moon’s south pole, the article does not indicate how it was formed or how much water ice scientists expected to be inside it. B. This is the correct answer. According to paragraph 2, water ice is most likely found in deep craters that do not receive sunlight. C. Although the article states that deeper craters receive less sunlight and thus experience less evaporation of water ice, there is no indication that smaller craters preserve water ice. D. Although the *LCROSS* “radioed back what it saw,” there is no evidence to suggest better visibility outside of the Cabeus crater.
7 Part B	**D**		A. Although the first two paragraphs discuss water ice on the Moon, they focus on how water traveled to the moon rather than how it could remain on the surface. B. Although the first two paragraphs discuss water ice on the Moon, they focus on how water was scattered and mostly evaporated on the Moon, not how it remains on the surface. C. Although the first two paragraphs discuss water ice on the Moon, they do does not identify where scientists expected to find water ice. D. This is the correct answer. This detail connects the ideas that the depth of craters and the lack of sunlight allow water ice to remain on the surface of the moon.

Question Number	Correct Answer(s)	Standards	Rationales for Answer Options
8	**See top-score bullets in right-hand column.**	**RI.5.3, RI.5.2, RI.5.1, W.5.2**	A top score will include: • Evidence of water on moon first found in 1994 • Spacecraft *Clementine* found hints of ice in craters • Earth's radar telescopes could not see ice • Scientists sent *Lunar Prospector* in 1998 • It found ice crystals in lunar soil at poles • Scientists were convinced there was water, told media • To confirm, scientists let *Lunar Prospector* crash into crater • Crash did not reveal water as expected • LCROSS was sent in 2009 • Crashed into crater • Dust cloud revealed water—mystery solved!