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Final Project: Designing an Objective Item and Performance Test

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Final Project: Designing an Objective Item and Performance Test

This project shows the application of effective measurement and evaluation in an educational setting, focusing on the development of assessment instruments for classroom use. It showcases the creation of an objective test and a performance-based assessment, aligning with the principles of test development and issues surrounding their implementation (Kubiszyn & Borich, 2024, pp. 1–23).

Part A: 1.0 Context

This project details the comprehensive development of a criterion-referenced test specifically designed to evaluate fourth-grade students' understanding of Earth in Space & Time concepts (Kubiszyn & Borich, 2024, pp. 75–94). Its design rigorously aligns with five key Florida science standards (SC.4.E.5.1 through SC.4.E.5.5) (Florida Department of Education, n.d.). The assessment is tailored for a diverse elementary classroom setting, accommodating 25 students, including those with limited English proficiency (LEP) and cognitive impairments. Its design rigorously aligns with five key Florida science standards (SC.4.E.5.1 through SC.4.E.5.5), which encompass a range of topics: star patterns and celestial movement, lunar phases, Earth's rotation and revolution, the apparent movement of celestial bodies, and the broader impact of space research on Florida's economy and culture.

The assessment itself is a 45-minute, 15-item test that uses a combination of multiple-choice and true/false formats. A critical aspect of its design involves strategic accommodations to ensure accessibility while maintaining academic rigors for all learners. These accommodations include simplified language, visual supports, and structured question formats to aid English language learners, as well as specific provisions for students with exceptional education needs (ESE) (Florida Department of Education, n.d.; Kubiszyn & Borich, 2024, pp.

24–41). The test places a significant emphasis on higher-order thinking skills, with 62% of the total points given to analysis and synthesis levels (Popham, 2003). This structure reflects current educational priorities, moving beyond rote memorization to foster a deeper conceptual understanding. The anticipated results from this assessment will be instrumental in informing instructional decision-making, identifying specific knowledge gaps, and determining student readiness for more advanced astronomical concepts, thereby enhancing educational effectiveness for all students. See Table 1 for the details of the objective test foundation.

Table 1

The Foundation for the Objective Test

Item	**Description**
1.1 Age/Grade Level	9–10 year-olds, 4th grade level
1.2 Subject & Unit	Science: Earth in Space & Time
1.3 Test Type	Criterion Referenced
1.4 Test Purpose	This criterion-referenced assessment evaluates fourth-grade students' understanding of key Earth in Space & Time concepts, as defined by Florida science standards. It measures students' ability to recall scientific facts, identify and analyze relationships between Earth and celestial phenomena, and apply scientific reasoning to interpret information about Earth's place in space and time. The results will be utilized to narrow specific knowledge gaps, inform targeted instructional adjustments, and determine student readiness to progress to more advanced concepts within this unit. Designed for inclusivity, the assessment incorporates accommodations for Limited English Proficiency (LEP) and Exceptional Student Education (ESE) students through simplified language, visual supports, and clearly structured questions.

Part A: 2.0 Objectives

To create effective instructional objectives, they must align with the educational goal, addressing specific requirements and focus. Objectives should match the complexity of the goal, being appropriate for the learners' level. Each objective must define the learning conditions, specific content to be mastered, and observable student behaviors. These objectives should be measurable, allowing educators to assess student performance through clear, quantifiable outcomes. See Table 2 for the instructional objectives for each Common Core Standard.

Table 2

Instructional Objectives for SC.4.E.5 Standards

SC.4.E.5.1: Observe that the patterns of stars in the sky stay the same, although they appear to shift across the sky nightly, and different stars can be seen in different seasons. By the end of the lesson, students will be able to: ● Knowledge 90% accuracy: Identify the consistent patterns of stars in the night sky by labeling a provided star chart. ● Comprehension 85% accuracy: Describe the apparent night shift of stars and seasonal differences in visible stars through a written explanation. ● Application 80% accuracy: Demonstrate the movement of stars across the sky by creating a model or diagram showing nightly shifts.
SC.4.E.5.2: Describe the changes in the observable shape of the Moon over the course of about a month. By the end of the lesson, students will be able to: ● Knowledge 90% accuracy: Identify the phases of the Moon by labeling a provided diagram of the lunar cycle. ● Comprehension 85% accuracy: Explain the changes in the Moon’s observable shape over a month through a short paragraph. ● Application 80% accuracy: Predict the next Moon phase given a sequence of lunar phase images.
SC.4.E.5.3: Recognize that Earth revolves around the Sun in a year and rotates on its axis in a 24-hour day. By the end of the lesson, students will be able to: ● Knowledge 90% accuracy: Define Earth’s revolution and rotation by matching terms to their definitions. ● Comprehension 85% accuracy: Explain how Earth’s revolution around the Sun and rotation on its axis affect time and seasons through a provided graphic organizer.

- Application 80% accuracy: Model Earth's revolution and rotation using a physical or digital simulation.

SC.4.E.5.4: Relate that the rotation of Earth (day and night) and the apparent movements of the Sun, Moon, and stars are connected.
By the end of the lesson, students will be able to:

- Knowledge 90% accuracy: Identify the relationship between Earth's rotation and the apparent movement of celestial bodies by completing a matching activity.
- Comprehension 85% accuracy: Describe how Earth's rotation causes the apparent movements of the Sun, Moon, and stars in a short written response.
- Application 80% accuracy: Create a diagram illustrating the connection between Earth's rotation and the apparent movements of the Sun, Moon, and stars.

SC.4.E.5.5: Investigate and report the effects of space research and exploration on the economy and culture of Florida.
By the end of the lesson, students will be able to:

- Knowledge 90% accuracy: List at least three effects of space research on Florida's economy and culture by completing a chart provided.
- Comprehension 85% accuracy: Explain the impact of space exploration on Florida's economy and culture through a short presentation or written report.
- Application 80% accuracy: Research and summarize a specific example of how space exploration has influenced Florida's economy or culture in a short paragraph.

Part A: 3.0 Table of Specifications

The table of specifications serves the purpose of being the blueprint that aligns with instruction and assessment. It ensures both instruction and assessment objectives are represented while promoting balance within the covered materials across various cognitive levels.

Below in the table of specifications is an outline of the content that will be assessed on the fourth-grade Earth Science test. This test will target knowledge, comprehension, analysis, and synthesis learning levels with a variety of item formats such as multiple choice, fill-in-the-blank, and true or false questions.

Table 3

Table of specifications

Test Specification Table with Weighted Scores - 4th Grade Earth Science - Astronomy Standards							
Content Outline	**Learning Levels**				**Total # of Items**	**Total Points**	**Weight (%)**
	Knowledge	Comprehension	Analysis	Synthesis			
	Number of Items (Format)/Points						
SC.4.E.5.1: Star Patterns and Movement							
a. Given an example statement, identify the patterns of the stars in the sky.	1 (MC) 4 pts.	1 (MC) 5 pts.			2	9 pts.	9%
b. Given a constellation in the sky, identify the change of stars during different seasons.			1 (MC) 7 pts.		1	7 pts.	7%
SC.4.E.5.2: Moon Phases							
a. Given an example problem, identify patterns of the moon with 100% accuracy.	1 (MC) 4 pts.				1	4 pts.	4%
b. Given an image, identify the phases of the moon with 100% accuracy.			1 (MC) 8 pts.		1	8 pts.	8%
c. Identify how long the cycles of the moon last based on the phases.		1 (MC) 5 pts.			1	5 pts.	5%
SC.4.E.5.3: Earth's Rotation and Revolution							
a. Given that the Earth revolves around the Sun in a year, identify at least one of the factors for the occurrence of seasons on Earth.		1 (MC) 5 pts.			1	5 pts.	5%
b. Given that the Earth rotates on its axis in a 24-hour day, select the correct explanation for the occurrence of day and night.	1 (FB) 4 pts.				1	4 pts.	4%
c. Evaluate the statement about Earth's orbital period	1 (T/F) 3 pts.				1	3 pts.	3%
SC.4.E.5.4: Earth's Rotation and Apparent Movement							
a. Given the rotation of Earth (day and night), explain how the apparent movements of the Sun, Moon, and stars are connected.	1 (T/F) 3 pts.	1 (MC) 4 pts.			2	7 pts.	7%
b. Given the Earth's rotation, describe how this motion leads to predictable patterns in the apparent movement			1 (MC) 7 pts.		1	7 pts.	7%

Test Specification Table with Weighted Scores - 4th Grade Earth Science - Astronomy Standards							
of the Sun, Moon, and stars throughout the day and night.							
SC.4.E.5.5: Space Research and Florida							
a. Given Maya's family scenario, analyze how space exploration creates interconnected economic effects in communities.			1 (MC) 12 pts.		1	12 pts.	12%
b. Given the Governor scenario, synthesize economic and cultural evidence to create persuasive arguments about space research.				1 (MC) 13 pts.	1	13 pts.	13%
c. Given the Oklahoma class scenario, analyze multiple factors and synthesize information to predict the consequences of losing space research.			1 (MC) 16 pts.		1	16 pts.	16%
Total # of Items	**5**	**4**	**5**	**1**	**15**		
Total Points	**18 pts.**	**19 pts.**	**49 pts.**	**13 pts.**		**100 pts.**	
Weight (%)	**18%**	**19%**	**49%**	**13%**			**100%**

Note: 3.3 Marginal and Cells, and Weighted Score Legend:

MC = Multiple Choice | T/F = True/False | FB: Fill-in-the-blank

Key Insights:

- Higher-order thinking emphasis: 62% of points allocated to Analysis (49%) and Synthesis (13%)
- Space Research emphasis: SC. 4. E. 5.5 carries 40% of the total test weight (40 out of 100 points)
- Balanced coverage: All five astronomy standards represented with appropriate cognitive complexity.

Part B: 4.0 Objective test items

This section presents our 15 questions, which include multiple-choice, true/false, and fill-in-the-blank formats. Students are allocated 45 minutes to complete the test. The answer key is provided at the end of the document. Since the students are in 4th grade, images are included with each question to aid in visualizing the concepts.

Table 4

Assessment Instructions

Please read the following instructions carefully before beginning the assessment.

General Guidelines:

- Read each question and all provided answer choices thoroughly.
- Select only the best answer for each question.
- Ensure you answer every question.
- Only one answer choice is correct per item. Selecting more than one answer (whether correct or incorrect) will result in an incorrect mark for that question.
- If a picture or table is provided, use it to help you select the best answer.

Question Formats:

1. Multiple Choice: These items provide a list of answer choices. Your task is to select the single correct answer from the options given.
2. True/False: These items present a statement or question, followed by two choices: "True" and "False." You must select only one option that best represents the accuracy of the statement or the answer to the question.
3. Fill in the Blank: These items do not provide predetermined answer choices. You will need to recall facts or information to provide the correct answer in the space provided.

1. Why does the Big Dipper look like it moves across the sky during the night?

   a) The stars are moving around the Moon.
   b) The stars are getting brighter.
   c) The Earth's rotation.
   d) The Big Dipper changes shape.

2) Tiana enjoys watching the sky during different seasons. Tiana notices that she can see Orion in the winter, but not in the summer. What is the best explanation for this?
   a) The stars in Orion disappear in summer and spring.
   b) Clouds cover Orion in the summer night sky.
   c) Orion only shines brightly during cold, windy weather.
   d) Earth's position around the Sun changes the visible constellations.

1. At night, Maya sees the same group of stars in the sky. A few hours later, the stars are in a different place, but the shape of the group is still the same. What can be learned about the stars in the night sky?
    a. The stars began to move to a new shape every hour.
    b. During the night, the stars will change in size.
    c. The pattern of stars stays the same, but they appear to move across the sky.
    d. Each night, new stars appear every night in a different order.

2. Patterns in the sky can be seen at different times throughout the year. Why can we see some constellations in winter but not in summer?
    a. Earth does not move around the Sun, so the stars disappear in summer.
    b. Earth moves around the Sun, so we see different stars in different seasons.
    c. The Moon blocks the stars in summer and shines too brightly to see them.
    d. Stars move closer during the seasons of winter, spring, summer, and fall.

2. How long does it take for the Moon to cycle through all its phases?
    a. 24 hours
    b. 29 days
    c. 31 days
    d. 12 hours

2. Julian notices that on different nights, the shape of the Moon looks different. He decides to collect data on the phases of the Moon to find out how the Moon changes from night to night. If Julian writes down the phases of the Moon every night for 6 months, what pattern will he find?

    a. There are more new moons than any other phase of the Moon.
    b. There are more full moons than any other phase of the Moon.
    c. The new moon always happens 29 days after a full moon.
    d. The phases of the Moon always occur in the same order.

2. The moon does not emit light and must reflect the light from the sun, which causes the moon to appear in different shapes in the sky.
    __ True
    __ False

3. When Sonia checked the clock at 12 PM, the sun was directly overhead. If Sonia wanted to see the sun in that same position tomorrow, how many hours would be required?
    a. 36 hours
    b. 24 hours
    c. 23 hours
    d. 12 hours

2. The Earth rotates on its _____.

3. The stars look like they move through the sky because of the rotation of the Earth.
   __ True
   __ False

4. In which direction do stars and the Sun appear to move over the sky?
   a. Up and down
   b. East to West
   c. West to East
   d. North to South

2. Sarah looks up into the dark sky at 10 PM and sees Gemini, the pattern of stars. However, if she were to turn around 5 hours later, what would the sky look like?

   a. After five hours, the moving stars are in the same position as before.
   b. The turning stars should be in quite different positions after five hours.
   c. No longer would one be able to see the turning stars in the sky at all.
   d. It has moved now to become the pattern of stars called Aquarius.

1. Maya's family moved to Florida because her dad got a job building parts for rockets at Kennedy Space Center. Her mom opened a restaurant near the space center that serves food to tourists who come to watch rocket launches. Analyze how space exploration has created a "chain reaction" of economic effects in Maya's community. Choose the answer that BEST explains this connection.
   a. Space exploration only affects people who work directly for NASA at the Kennedy Space Center.
   b. The space program has no connection to local businesses like restaurants or bakeries.
   c. Space exploration only brings tourists to Florida’s Kennedy Space Center once per year.
   d. Space exploration creates jobs in many different industries because each business supports the others.

2. The Governor of Florida wants to convince other states that space research is important for Florida's future. You are asked to create an argument using evidence. Combine what you know about space research's effects on Florida's economy and culture to write a strong argument. Which combination of evidence would make the BEST case?
   a. Space research brings tourists to the Florida coast, and it makes Florida schools more interesting.

   b. Space research creates jobs and inspires students to study STEM for future technology careers.
   c. Space research makes rockets, and Florida has good weather for launching them into space.
   d. Space research is expensive, but students like visiting space museums, which increases the economy.

2. A 4th-grade class in Oklahoma is studying space exploration. They want to understand why Florida became the center of America's space program instead of their state. Think of the factors that made Florida special for space research, then process this information to predict what might happen if space research left Florida. Choose the MOST COMPLETE answer.
   a. If space research left, the state would lose jobs and its reputation as a science leader.
   b. Florida has nice beaches, so if space research left, people would still visit for vacation.
   c. Space research chose Florida randomly, so leaving wouldn't matter much.
   d. Only the space museums would be affected if space research left Florida.

Answer Key:

1. C
2. D
3. C
4. B
5. B
6. D
7. False
8. B
9. Axis
10. True
11. B
12. B
13. D
14. B
15. A

Part B: 5.0 Performance-based test

The performance-based test outlined is a hands-on element to the objective test, engaging fourth-grade students in an activity that showcases their grasp of lunar phases (SC.4.E.5.2) (Kubiszyn & Borich, 2024, pp. 95–114). In the Oreo Moon Phases Activity, students use Oreo cookies to model the eight key moon phases, which helps them grasp the concepts while also

applying their knowledge in a practical way. This activity comes with straightforward instructions, structured guidance, and accommodations for LEP and ESE students, making it accessible for everyone (Florida Department of Education, n.d.; Kubiszyn & Borich, 2024, pp. 24–41). The rubric provided aligns with the project's criterion-referenced approach, giving a solid framework for evaluating student performance and helping inform any necessary instructional adjustments (Kubiszyn & Borich, 2024, pp. 75–94).

Table 5

Oreo Moon Phases Activity

Objective:
Under the guidance of the teacher, students will demonstrate their understanding of the eight essential moon phases by carefully shaping Oreo cookie cream to represent each phase and arranging them in the correct order. This activity illustrates how the moon's appearance changes over a 29.5-day cycle due to its position relative to Earth and the Sun (Florida Department of Education, n.d.).

Materials:

- 10 Oreo cookies (2 extra in case of breakage)
- Plastic knife or popsicle stick
- Paper plate or construction paper (for displaying the phases)
- Moon phase labels (optional: preprinted cards or handwritten)
- Napkin or paper towel
- Pencil
- Reference diagram of moon phases (provided by teacher)
- Optional: Gluten-free or alternative cookies for dietary restrictions

Student Directions:

1. **Prepare the Cookies:** Carefully twist 8 Oreo cookies, aiming to keep the cream on one side of each cookie. If a cookie breaks or cream splits, use one of the spare cookies.
2. **Shape the Moon Phases:** Use a plastic knife or popsicle stick to shape the cream on one half of each cookie to represent the following moon phases:
    - New Moon: No cream showing (scrape off all cream).
    - Waxing Crescent: Partial to 1/4 cream on the right side.
    - First Quarter: Half cream on the right side.
    - Waxing Gibbous: 3/4 cream on the right side.
    - Full Moon: All cream is visible.
    - Waning Gibbous: 3/4 cream on the left side.

- Last Quarter: Half cream on the left side.
- Waning Crescent: 1/4 cream on the left side.

3. **Arrange the Phases:** Place each cookie in the correct order of the lunar cycle (New Moon → Waxing Crescent → First Quarter → Waxing Gibbous → Full Moon → Waning Gibbous → Last Quarter → Waning Crescent) on your plate or paper. Refer to the provided moon phase diagram to confirm the sequence.
4. **Label the Phases:** Print the name of each phase on the plate/paper or place preprinted labels next to the corresponding cookies.
5. **Verify Your Work:** Double-check your sequence and cream shapes using the moon phase reference diagram. Ensure waxing phases (growing) are on the right and waning phases (shrinking) are on the left.
6. **Explain Waxing vs. Waning:** Be prepared to explain the difference between waxing and waning phases to your teacher (e.g., "Waxing means the moon appears to grow larger; waning means it appears to shrink").
7. **Clean Up:** Place any cookie scraps on the napkin and clean your work area.
8. **Submit for Assessment:** Raise your hand when finished for the teacher to check your work.
9. **Note:** This activity should take approximately 20–30 minutes. If you have dietary restrictions, inform your teacher to use alternative cookies.

Teacher Assessment Checklist

Criteria	Yes	No	Comments
1. All 8 moon phases are shown	❑	❑	
2. Phases are arranged in the correct order (starting with New Moon)	❑	❑	
3. Oreo cream shapes accurately represent each phase	❑	❑	
4. Labels are correctly matched with each phase	❑	❑	
5. Student can explain the difference between waxing and waning (e.g., via verbal explanation or written note)	❑	❑	
6. Student worked carefully and used materials properly (e.g., minimal waste, clean workspace)	❑	❑	
7. Student participated actively and stayed on task	❑	❑	

Total Score: _____ / 7

Rubric: Oreo Moon Phases Activity

Score	Grade	Description
7/7	A (90-100%)	All phases are shown, correctly ordered, accurately shaped, labeled, and the student demonstrates understanding of waxing/waning; worked carefully and stayed on task.
6/7	B (80-89%)	One minor error in phases, order, shapes, labels, or understanding; worked carefully and stayed on task.
5/7	C (70-79%)	Two errors in phases, order, shapes, labels, or understanding; mostly careful and on task.
4/7	D (60-69%)	Three errors in phases, order, shapes, labels, or understanding; some lack of care or focus.
0-3/7	F (0-59%)	Significant errors in multiple criteria; lack of care or engagement.

Part B: 6.0 ESE and LEP Modifications

This assessment is designed for a 4th-grade elementary classroom with 25 students, including those with diverse learning needs. The test is criterion-referenced, aligning with specific learning objectives. Students will have 45 minutes to complete the assessment. Accommodations are provided for students with Limited English Proficiency (LEP) and students receiving Exceptional Student Education (ESE) services to support their unique learning needs and ensure equitable access to the curriculum. These accommodations are implemented in alignment with each student's documented plan and in collaboration with staff and families.

Table 6

Accommodation for Diverse Learners

LEP Student Accommodations

The LEP student, who recently moved from India, possesses a strong understanding of science concepts but may struggle with English science vocabulary. She benefits from visual aids and simplified language. Accommodation for this student will include:
Oral reading of test items: To assist with vocabulary comprehension.

- Access to a general word bank: Specifically, to support fill-in-the-blank questions.
- Extended time: To allow sufficient processing time.
- Visual aids and simplified language: Incorporated into the test design where appropriate.

ESE Student Accommodations

The ESE student has cognitive impairment, processes information more slowly, and benefits from concrete examples, repetition, and simplified concepts. He works with a paraprofessional for part of the day. Accommodation for this student will include:

- Frequent breaks: To aid in supporting focus and managing cognitive load.
- Test items read aloud: To aid with comprehension and reduce reading demands.
- Choice to reread questions or have items reread aloud: To reinforce understanding.
- Extra time to complete the test: To ensure adequate processing and response time.
- Preferential seating near the teacher: To provide easy access to support and minimize distractions.
- Small group testing setting: To offer a more focused and less stimulating environment.
- Testing in an environment with reduced stimuli: To minimize distractions and enhance concentration.
- Verbal encouragement: To provide positive reinforcement and support motivation.
- Ability to pause and play test items being read: To allow for self-pacing and repeated listening.

Concluding Remarks

This report details the creation of a criterion-referenced assessment tailored specifically for fourth-grade students, concentrating on concepts related to Earth in Space & Time. The assessment is carefully aligned with five key Florida science standards: SC.4.E.5.1, SC.4.E.5.2, SC.4.E.5.3, SC.4.E.5.4, and SC.4.E.5.5. These standards cover a range of topics, including star patterns, lunar phases, Earth's rotation and revolution, apparent celestial movement, and the importance of space research.

The assessment is designed for a diverse classroom of 25 students, which includes those with Limited English Proficiency (LEP) and cognitive impairments. It consists of distinct types of questions: multiple-choice, true/false, and fill-in-the-blank. It is to be completed in 45 minutes. With a total of 15 items, the test prioritizes higher order thinking skills, distributing 62% of the total points to analysis and synthesis. This structure encourages students to gain a deeper conceptual understanding instead of just memorizing facts.

To enhance accessibility while maintaining academic rigor, we have integrated specific accommodations into the assessment. For LEP students, this means using simplified language, adding visual support, and following a structured question format. Students with exceptional education needs (ESE) will receive tailored accommodation, including frequent breaks, read-aloud options for test items, extended time, preferential seating, and reduced-stimuli testing environments, all aligned with documented student plans.

Using criterion-referenced assessments in this initiative allows us to measure student proficiency against specific benchmarks rather than comparing them to one another. The results will be instrumental in pinpointing knowledge gaps, guiding instructional adjustments, and assessing student readiness for more advanced concepts in astronomy. Overall, this approach aims to enhance educational accessibility and effectiveness for all learners, particularly those with LEP and ESE needs.

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