3.2 Create a lunar landscape

This 100-minute STEAM program helps 1st-grade students understand gravity and how Moon craters are formed. Kids start by jumping and feeling how gravity pulls them down, then they listen to a story about the Moon. Using a sandbox and different stones, they experiment to see how the weight and size of an object change the crater it makes. They learn cool facts, like how heavy and light objects actually fall at the same speed, which often surprises them. Finally, the students use what they learned to design their own lunar landscape and explain their "scientific" results.

Basic Information Sheet

Age group/ Grade	Student number	Duration	Number of stages	Subjects connection and relevance
1st grade students	Whole class	100 minutes	4 stages	natural sciences, visual arts, native language (vocabulary expansion, awareness), mathematics

STEAM Event Summary

SPIRIT Skill Focus

- Problem-solving
- Curiosity, sense of wonder and openness

National curriculum Link and Objectives

Science objectives:

- Students investigate different types of forces: gravity.
- Students describe the Moon: craters.
- Students learn the basic principles of doing scientific research: careful observation and fair comparison.

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Arts objectives:

- Reflecting on images.
- Describe the impressions evoked by the observation. E.g.: What do I see in this image? How might this image have been created?
- Recognising and organising simple shapes.
- Creating an image (2D or 3D) by deliberately placing objects in space. E.g.: designing a robot, utilising the space on the page

Math objectives:

- Measuring: bigger, heavier, deeper, etc.

Language objectives:

- Listening to narrative and artistic-literary texts:
- Based on age-appropriate spoken stories, students will be able to:
- Understand the essence of the story;
- Follow and understand the storyline;
- Reconstruct the storyline fairly literally;
- Express personal feelings and opinions about the story;
- Distinguish between reality and fantasy;
- Assess the authenticity of story details.
- Reflecting on word meanings in concrete speaking situations
- Answer teacher questions about a topic covered within different subject areas:
- Respond to questions related to meanings

Real-world STEAM Connection and Problem definition

The Moon is a celestial body that children see every day, always in a different phase, and it strongly captures their curiosity. Many images of the Moon show craters. In this STEAM activity, children will investigate, on the one hand, how craters are formed and, on the other hand, what is the impact of gravity is on the falling of different objects in size and weight.

In addition, misconceptions about gravity are addressed. For example, children are often surprised that a feather and a stone fall at the same speed. By experimenting and exploring (e.g., experiencing gravity with objects, specifically stones), they acquire the necessary knowledge.

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As an application, children are challenged to recreate a lunar landscape with craters of different sizes by dropping stones. In this way, they actively apply the knowledge they have learned.

Materials at a Glance

- Story: pictures from the picture book: Journey to the Moon (see attachment)
- Stones preferably with an irregular shape, both large and small, both light and heavy.
  Ideally:
  - Large and heavy
  - Large and light (e.g. lava stone, but could also be replaced by a sponge)
  - Small and heavy
  - Small and light
- White sand
- A container (that can hold at least 5 cm of sand)
- (alternatives: sandbox in the playground, flour instead of sand; flour creates more dust/sticks more, sand is “cleaner”)
- A small squeegee (to smooth the sand evenly each time)
- A folding ruler (so the children can easily see from what height their object falls)
- A globe
- A moon (about 1/4 the size of the globe, e.g. a tennis ball painted black).

Indoor/Outdoor and Classroom layout

We recommend that the program be implemented in an indoor setting. In this case, the recommended spatial layout for the program is as follows:

- Space for jumping: (e.g., behind their chairs)
- Space to listen to the story
- Space to conduct the stone experiment.
- Space to discuss the conclusion.

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Notes on Research-based approach and integration

In the activity, they start with an open-ended investigation, which, under guidance, evolves into a structured "child-friendly scientific inquiry." From this, they learn the underlying principles. They are required to apply mathematical skills and prior knowledge, such as measuring and estimating, in order to record and compare the results of their investigation.

Lesson Flow Overview (linked to details below)

Stage	Title	Brief Description	SPIRIT Skills	Duration	Link to Details
1st	**Exploring gravity with own body**	Students will experience certain principles of gravity. • The students explore and reflect on this (through the teacher's guiding questions). • How high can you jump? Try jumping "high." Can you jump higher? • Who can stay in the air? • Can you fall down more slowly after jumping? • Let your head hang down. What do you feel? • (optional: give someone a backpack with a weight inside → how does that feel?) Essence / conclusion: We are always pulled towards the ground. We cannot stay in the air. There is an invisible force that pulls everything to the ground. This is gravity	• Problem-solving • Curiosity, sense of wonder and openness	10 minutes	**STAGE 1 – Exploring gravity with own body**
2nd	**Reading Journey to the Moon**	The students study a lunar landscape from a picture book. The teacher shows the illustrations while telling the story.	• Problem-solving • Curiosity, sense of wonder and openness • Critical thinking	20 minutes	**STAGE 2 – Reading Journey to the Moon**

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3rd	**Investigating Gravity - Inquiry-based learning**	**Afterwards, they investigate how to play with the size and depth of craters from gravity.** Students receive a box with various stones and a sandbox. A. They may freely explore crater formation. (*e.g. guiding questions: create craters of different sizes/depths. How can you make the largest/deepest craters?*) • Briefly discuss what they have observed. • Encourage them to describe their observations as precisely as possible! • Optionally compare the craters made by the children with photographs of real craters on the Moon. B. Then move on to a focused investigation. Central research question: *What determines the size (depth and width/length) of a lunar crater?* Ensuring a fair test (explicitly explain to students) • Always drop from the same height. • Hold the stone still and simply let it fall (starting speed always zero). • Always drop straight down. • Change only one variable at a time (e.g. not comparing large and heavy with small and light). • Smooth the sand after each test.	• Problem-solving • Curiosity, sense of wonder and openness • Critical thinking	30 minutes	**STAGE 3 – Investigating Gravity: Inquiry-based learning**

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		Guided investigation steps **B1. The role of mass (weight) of the stone** • Hypothesis: The heavier the meteorite, the deeper the crater will be. • Use objects that are the same size but with different mass. • First let students sort stones into two groups: light and heavy. • Discuss together how they can judge if something is heavier or lighter. • Then let them test: take two stones of the same size but different mass and compare crater depth. **B2. Do heavy and light stones (same size) fall at different speeds?** • Likely, students think a heavier stone falls faster. • Let them test: drop a heavy and a light stone from the same height at the same time. • They discover: both hit the ground simultaneously → surprise → discussion: Why is that? • Key concept: mass does not affect falling speed. • Follow-up: if they fall at the same speed, why is one crater bigger/deeper? → Because of the impact force. **B3. The role of size of the stone** • Use objects that are equally heavy/light but differ in size. • Compare the craters formed			

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4th	**Final task: Design-based learning, designing a lunar landscape**	At the end they make in sand with falling objects lunar landscapes with different crater sizes. **Final task: Create a lunar landscape with 4 craters** • 1 large/long and deep crater • 1 small/short and shallow crater • 1 large (long) and deep crater • 1 large (long) and shallow crater Take a photo in black and white: • once with the stones next to the craters • once without the stones. Afterwards, students explain how they formed this landscape. They must use the scientific vocabulary they have learned.	• Problem-solving • Creativity • Critical thinking • Resilience • Flexibility • Curiosity, openness and sense of wonder	20 minutes	**STAGE 4 - Final task: Design-based learning, designing a lunar landscape**

Tips and Tricks for dealing with challenges (for the whole STEAM program)

- Monitor the lesson time. Depending on this, you can shorten or extend Stage 3 with the different sub-topics.

Difficulty level tailoring notes

The selection of stones is very important. This determines the difficulty of the categorization.

STEAM Program Debriefing and Reflection Questions

- What surprised you the most about the Moon?
- What surprised you the most about gravity?
- What was the biggest challenge in the gravity investigation?
- What would you do differently next time in the investigation?
- What difficulties did you encounter when designing a lunar landscape?
- What is the most useful tip you would give to other groups based on your experience during the investigation.

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3.2.2. Stage details and Activities Flow

STAGE 1 – Exploring gravity with own body

How does this develop particular SPIRIT skills

The teacher's challenge - to stay "longer" in the air - They wonder when they try to stay in the air that they always fall back to the ground. They experience this with their own bodies. In particular, it helps them realize that it is not possible to stay 'longer' in the air.

What do we want to achieve regarding SPIRIT skill development (student understanding and/or behaviour)?

Children learn to think critically about gravity by experimenting with their own bodies, for example by jumping, trying to fly or dropping objects. They experience what works and what doesn't, ask themselves questions and look for explanations. You can see problem-solving thinking in:

- Trying out different ways to jump higher or stay in the air longer
- Comparing their own experiences with those of others ('Why can you jump further?')
- Searching for solutions ('What if I take a run-up before jumping? Why am I not flying now?')
- Adjusting their approach after feedback or failed attempts

Their behaviour shows curiosity, experimentation and a search for explanations. Their results demonstrate a growing understanding of what gravity does and why some solutions work and others do not.

Academic/Curriculum Objective connection

Science: gravity

Materials and tools needed for implementation

No special materials are needed for implementation

Preparation notes

Does not require any special preparation on the behalf of the teacher

Guided Questions

- Who can jump the highest?
- Who can stay in the air the longest?
- Why can't we stay in the air for long?
- Is there a force that pushes us to the ground?
- Is it everywhere? Where is it and where isn't it?

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Stage Debriefing Questions (Optional)

- When you tried to jump as high as you could, what happened every single time you tried to stay up in the air?
- What do you think was pulling you back down to the ground instead of letting you stay up in the sky like a bird?
- Do you think this invisible 'pull' happens only when we jump, or does it happen to other things too?
- Can you think of something else that always falls back to the ground?

These questions are designed to be open-ended, allowing the students to voice their observations and start forming their own understanding of gravity through their unique perspectives.

Tips and Tricks for dealing with stage challenges

Important misconception to avoid: Do not say: we are pulled “down”, because then you get the problem of “people in Australia” standing “upside down” without falling off the Earth. Instead, say: we are pulled toward the ground / toward the Earth.

STAGE 2 – Reading Journey to the Moon

How does this develop particular SPIRIT skills

To spark wonder about the Moon and, through various questions, lead the students to the topic of craters.

What do we want to achieve regarding SPIRIT skill development (student understanding and/or behaviour)?

You can amaze children and spark their curiosity during a picture book story about gravity and the lunar landscape by telling the story vividly, asking questions and leaving room for wonder. Use surprising illustrations, let children imagine what it feels like to jump on the moon, and compare this to their own experiences on Earth. You will see curiosity, sense of wonder in:

- Wide eyes, open mouths, or enthusiastic reactions (‘Wow, can you really jump that high on the moon?’)
- Asking lots of questions (‘Why do things float there?’)
- Imagining and sharing their own ideas (‘Could you fly if you took a big jump?’)
- Wanting to imitate or experiment after the story (jumping, dropping things, drawing)

Their behaviour shows that they are fascinated, actively thinking along and want to discover more. Their results include imaginative drawings, stories or experiments that build on the picture book.

Academic/Curriculum Objective connection

- Listening to narrative and artistic-literary texts:
- Based on age-appropriate spoken stories, students will be able to:
    - ➢ Understand the essence of the story;
    - ➢ Follow and understand the storyline;
    - ➢ Reconstruct the storyline fairly literally;

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- Express personal feelings and opinions about the story;
- Distinguish between reality and fantasy;
- Assess the authenticity of story details.

- Reflecting on word meanings in concrete speaking situations
- Answer teacher questions about a topic covered within different subject areas:
- Respond to questions related to meanings;

Materials and tools needed for implementation

Pictures of the moon landscape.

Preparation notes

Story of the book.

Guided Questions

- What does the moon look like in the picture?
- Have you ever seen a crescent moon like this?
- Can the moon look different?
- Is the moon really just a crescent?
- What shape is the landscape?
- Is the landscape flat? Or are there places where you go uphill?

Stage Debriefing Questions (Optional)

- If you could jump on the moon just like the character in our story, do you think you would jump higher or lower than you did in our classroom, and why?
- The story showed us that the moon has many big, round holes called craters. What do you imagine happened to create those shapes on the surface?
- If you were packing a suitcase to go on a trip to the moon like the characters in our book, what is the one special thing you would want to take with you to help you explore, and why?

Tips and Tricks for dealing with stage challenges

Not Applicable.

STAGE 3 – Investigating Gravity: Inquiry-based learning

How does this develop particular SPIRIT skills

This phase significantly promotes critical thinking, curiosity, wonder, and openness, as well as scientific questioning, as it guides children from unstructured play toward systematic observation. Through interaction with the physical environment—specifically, by using the sandbox and various types of rocks—students actively practice the skills of observation, formulating and testing hypotheses, and isolating and identifying variables. At this stage, children discover gravity through hands-on experience, which helps them think like “scientists.” By playing with different rocks in the sandbox, they learn to observe small details and ask questions (“What happens if…?”), which lays the foundation for their critical thinking. When they realize that they need to change their strategy for the experiment to succeed (for example, how to drop the rock), this directly develops their problem-solving skills.

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This activity guides them from passive reception to active discovery, where they discover cause-and-effect relationships (weight of the stone = depth of the crater) on their own, rather than having them handed to them

What do we want to achieve regarding SPIRIT skill development (student understanding and/or behaviour)?

As the result of this stage's activities, we want to achieve the followings:

- Observation-based Critical thinking: We want the children not only to "throw" the rocks but also to observe what happens. The goal is for them to try to describe exactly what they see: "Look, this rock made a hole as big as a palm!"—this is the first step toward scientific observation.
- Experiment-Based Problem-solving and discovering Cause-and-Effect Relationships: The goal is for them to learn, in accordance with their age-appropriate characteristics and knowledge, the connections between the experiment and the underlying causes. A key objective is for children to discover simple cause-and-effect relationships on their own. For example, that the heavier stone creates a deeper crater because it hits the sand with greater force. This doesn't need to be explained to them; instead, they should be allowed to see it with their own eyes during the experiment.
- Curiosity and Openness – experiencing Wonder: We want the children to be excited by the discovery. When they realize that heavy and light stones hit the ground at the same time, their surprise is the most important part: this helps them remain open to new ideas and not just believe what they had assumed beforehand.

Academic/Curriculum Objective connection

- Exploring gravity and the force of impact.

Materials and tools needed for implementation

Sandbox, stones, measuring tools, windscreen wiper.

Preparation notes

To carry out this section effectively, teachers should prepare sandbox boxes and create a collection of rocks in advance, with stones of varying weights and sizes. It is helpful to have photographs of real lunar craters on hand to bridge the gap between the classroom experiment and reality. Before beginning, the teacher should briefly explain how to conduct a "successful experiment." This includes introducing the students to specific procedural rules: the rock must always be dropped from the same height; before dropping it, the student must ensure that the rock is completely motionless so that its initial speed is zero; the rock must be dropped straight down; and the sand must be smoothed out after each trial. Teachers should also be prepared to guide students through the sorting process, helping them categorize the stones into "light" and "heavy" groups to facilitate comparison.

The teachers have to:

- Categorize the stones beforehand into lighter and heavier, smaller and larger.
- Carry out the research question and procedure step by step with them (providing more whole-class guidance).
- Provide individual support for a group.

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Guided Questions

- Are there light and heavy stones or are they all the same?
- Which stone created the "largest" crater?
- Which created the deepest crater?
- Which stone falls the fastest?
- How can we test the fall of our stones so that the same thing can be examined for everyone?

Stage Debriefing Questions (Optional)

- What was difficult about working with the stones?
- When we let the stones fall, it was like a race! Did the heavy stone win the race, or did they land in the sand at the exact same time?
- Both stones landed at the same time, but look at the holes—why do you think the heavy one made a deeper 'splat' in the sand than the light one?
- If you look at our sandboxes and the pictures of the Moon, what do you see that looks the same?
- Can you spot any craters in our sand that look like the ones we saw in the pictures?

Tips and Tricks for dealing with stage challenges

- The temptation to "throw": It's a child's natural instinct to throw the stones into the sand to see a big "splash," rather than just dropping them. in this cae don't present the rule as a "ban," but rather as part of a story. Tell them that their hands are now a precise "landing craft" that must remain completely still when they release the stone so that the experiment is accurate.
- The embarrassing result: Children are often convinced that the heavier stone falls faster, and they are surprised (or even embarrassed) when they see that the heavy and light stones hit the ground at the same time. In this case don't explain complicated laws of physics to them. Use this moment to spark their curiosity. Ask them, "Did you expect the heavier one to be faster? Why did this surprise us?" This will help them trust their own observations rather than their preconceived notions.
- Smoothing the Sand: Smoothing the surface of the sandbox after every single throw might seem like a bit of a tedious task for a 6-year-old. Inthis case we suggest to rename this step "preparing the landing site." Tell them that every professional lunar explorer needs a clean, flat "landing site" so that the results of the next exciting experiment will be clearly visible.
- "Fluctuation" in the height of the throw: It can be difficult for children to release the rocks from exactly the same height every time, since their hands aren't steady enough yet or they might not be paying attention. If one stone falls from a higher height than another, the experiment will no longer be "fair," and the results will not be comparable. In such cases, mark a specific height using a tool that indicates where the stone should be dropped from. This gives the children a visual guide to follow, making it easier for them to work accurately.

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STAGE 4 – Final task: Design-based learning, designing a lunar landscape

How does this develop particular SPIRIT skills

Cause-and-effect-based critical thinking: The children draw on the "experiences" they gained in previous experiments. They no longer make random attempts but instead deliberately and consciously select the appropriate rock (weight, size) for a given crater because they understand the relationship: a heavier or larger rock leaves a different mark than a lighter one.

Problem-Solving and Design: The task is to accurately create a predefined "map of the Moon," which requires serious visual and creative design. The children must first imagine (visualize) the finished image, then put their plan into practice step by step. This helps them solve tasks while keeping the goal in mind, which is the foundation of problem-solving.

Creativity: Although the task is specific (they must create four specific types of craters), children must be creative in how they arrange them across the sandy "landscape" and how they shape the surface so that it truly resembles a lunar environment. In addition, they must take creative photos that—since they are black-and-white—can be compared to actual lunar photos. This creates a strong connection between the task, reality, and "theory."

Resilience and Flexibility: This phase puts their perseverance to the greatest test. If a crater isn't as deep or wide as planned, they don't give up but adjust their strategy (for example, by choosing a different rock or smoothing out the sand again). They learn that a "mistake" isn't a failure but a natural opportunity to improve the experiment, which increases their flexibility. In this way, children become open to experimentation and flexible adjustments.

Through the experience of curiosity and wonder, and through photography: Taking photographs is a magical part of the process that fosters a sense of wonder. When the children take the photos—especially the "with rock" and "without rock" versions—their own little sandbox suddenly transforms, through the camera's viewfinder, into a realistic, distant lunar landscape. This shift in perspective—seeing their own work through the "eyes of an astronaut"—deepens their enthusiasm for science and fills them with pride.

What do we want to achieve regarding SPIRIT skill development (student understanding and/or behaviour)?

Children learn problem-solving thinking about gravity when they drop different types of stones (large/small, heavy/light) into a sandpit to create a lunar landscape. Through experimentation, they discover how the stones create craters and what role gravity plays in this, how deep they sink, and what effects the weight and height of the drop have. You can see problem-solving thinking in:

- Trying out different stones and heights to see what effect this has on the sand
- Comparing results ('Which stone makes the biggest crater?')
- Adjusting their approach if something doesn't work ('Maybe I should hold the stone higher')
- Looking for solutions when a crater does not turn out well ('Can I press the sand differently?')
- Their behaviour shows curiosity, experimentation, comparison and improvement. Their results show different types of craters and a lunar landscape that shows they have thought about cause and effect.

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Academic/Curriculum Objective connection

- The application of gravity and its force on the impact when objects fall
- Creating an image (2D or 3D) by deliberately placing objects in space.
- Students learn the basic principles of doing scientific research: careful observation and fair comparison. In the translation it must be adapted! They are the national curriculum!

Materials and tools needed for implementation

Sandbox, stones, measuring tools, windscreen wiper, tablets, and/or cameras ((tripods).

Preparation notes

Visual aids: Supporting the planning phase is crucial for 6-year-old students. Create a simple illustrated chart (showing the 4 types of craters) that the children can see while they work. This will help students visualize the future landscape and consciously plan the sizes of the craters.

Science Vocabulary: An integral part of the activity is developing and using “scientific” vocabulary in their reports. Create flashcards with the words they’ve learned (e.g., crater, impact, depth, weight) to make it easier for them to use these terms in their reports.

Technology: Set up and test the tablet or camera in advance. Show the students how to take photos of the sand from above. Define fixed photography positions (tripod or a fixed camera position above the sandbox) so that the “with rock” and “without rock” photos can be clearly compared and evaluated.

Guided Questions

Since the task is complex (planning, execution, documentation, presentation) for 6-year-olds, the main point of our guidance in this case is not to provide the solution, but to offer direction that encourages them to discover things on their own.

Planning phase: These questions help children visualize and stick to their plan.

- Which stone on your tray looks the heaviest? What kind of mark do you think it will leave in the sand?"
- Take a look at your plan! Where do you want to make the deepest crater, and which stone will you try to use for it?
- Before you let go of the stone, think about it: how should you hold your hand so that your experiment is just as precise as when you practiced?

Challenges of execution phase (when they get stuck or the "crater" doesn’t work out). These questions support the resilience and flexibility when things don’t work out as planned.

- This crater turned out shallower than we’d hoped. What do you think would happen if you used a different stone?
- I know this turned out a little differently than you planned. Why do you think it took this shape?
- Look at your two attempts! What’s the difference between them? What might be causing this difference?" (Here, we draw attention to the cause-and-effect relationship.)
- How could you fix this crater so it looks more like your plan?

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Reflection and Wonder: These questions foster curiosity and a sense of pride.

- Look at the photo! Which crater turned out best, and why is that one in particular?"
- If an astronaut looked at your landscape, what would they think? Do you think they'd believe this is a real lunar landscape?"

Stage Debriefing Questions (Optional)

- Before you started creating the moon landscape, did you think about which crater you could make with which stone? Tell us how did you choose the stones for your design! Why did you think that you'd be able to make a 'big and deep' or a 'small and shallow' crater with that particular stone?
- We know that on the Moon, things don't always work as planned the first time. Was there a crater in your creation that didn't turn out exactly as you'd planned? What did you do in that case: how did you adjust your approach or the stones to ensure you were still satisfied with the result?
- We know that on the Moon, things don't always work as planned the first time. Was there a crater in your creation that didn't turn out exactly as you'd planned? What did you do in that case: how did you adjust your approach or the stones to ensure you were still satisfied with the result?

Tip for teachers: If the children get stuck while answering, don't give them the answer—instead, ask them a follow-up question: "Do you remember when we said the heavy rock made a loud thud? Do you think that helped make the crater deeper?" This way, you can guide them toward articulating cause-and-effect relationships.

Tips and Tricks for dealing with stage challenges

- Planning phase: It can be difficult for 6-year-olds to pay attention to 4 different types of craters at once. Use a simpler layout or fewer requested craters. Provide a pre-drawn plan or a photo to help them with their planning. For children who are more experienced with planning, give them a planning sheet (an A4 sheet) with four squares on it. The children can first sketch where they will place the large/deep or small/shallow craters.
- The difficulty of designing the craters: The "large but shallow" crater is a challenging task (it requires a light stone, but one that's large in size). If you see them getting stuck, show them an example: "Let's try using a stone with a large surface area but that's light!
- Check before taking photos: Taking photos is an exciting activity for children. That's why they often want to take a photo of their work quickly, before it's completely finished or before they've checked whether it matches the plan. Introduce a "Scientific Control" before taking photos. The children should compare the craters in the sand to their design sheets. Ask: "Is this crater deep enough compared to the design?" This step develops critical thinking and precision.
- The "failure-tolerant" retry: If a crater doesn't turn out right (e.g., it's not deep enough), a 6-year-old can easily get discouraged. Don't let them give up. Teach them the concept of "scientific correction": "Okay, this one didn't turn out deep enough, but what can we do? Which rock should we try again with, just on this small section?" This helps develop resilience and flexibility.
- The "failure-tolerant" retry: If a crater doesn't turn out right (e.g., it's not deep enough), a 6-year-old can easily get discouraged. Don't let them give up. Teach them the concept of "scientific

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correction”: “Okay, this one didn’t turn out deep enough, but what can we do? Which rock should we try again with, just on this small section?” This helps develop resilience and flexibility.

- Using “Scientific Vocabulary”: Six-year-olds don’t yet use scientific terms confidently. Create flashcards. These can help them when they present their lunar landscape, so they can use the new terms more confidently when describing cause-and-effect relationships.

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