# Enhancing Grade 5 Science Process Skills in Earth Science: A Foundation for Designing an Inquiry-Based STEAM Learning Packet

**Nichole G. Lindayao., Monera A. Salic-Hairulla., Angeline P. Dinoro., Ariel O. Ellare., Vanjoreeh A. Madale**

**Mindanao State University - Illigan Institute of Technology/College of Education, Department of Science and Mathematics Education**

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## ABSTRACT

Science yields a crucial role to our life, especially in this 21st century. Despite its importance acquiring scientific literacy remains a challenge for primary levels. Learners reveal to have low retention of concepts due to inadequate proficiency in Science Process Skills. These skills are vital for learners as this will be their instrument to master science concepts. It forms the bedrock for scientific investigation and exploration, gaining cognitive growth and active engagement in the learning process. This study addresses the low proficiency in science process skills and difficulties in Earth Science concept acquisition among Grade 5 learners in Iligan City, Philippines. With the result of the need assessment, the study aims to develop an inquiry-based STEAM (Science, Technology, Engineering, Arts, and Mathematics) learning packet to mitigate the issues. A mixed-method research design was employed. The results of this study from teachers (n=10) reveal challenges such as, 70% identified "inferring patterns in the changes in the appearance of the moon and its misconceptions" as the least mastered competency", 70% of the teacher relied on teacher-centered approach such as lecture and other online resources, and 83% of the teachers rated learners' SPS at partial mastery levels. Furthermore, the result on the SPS contradicts the learners' (n=40) assessment on their SPS (science process skills) through SPSI (Science Process Skills Inventory). In the result, 43-47% of the learners showed weaknesses in drawing conclusions, recording/estimating data, identifying facts vs. claims, and analyzing results, which these skills pertain to higher order skills of the SPS (see table to for frequency). With the abovementioned results, the study will use it as a basis in crafting a learning packet integrating STEAM approach and inquiry based learning frameworks, intending to enhance both learners' SPS and Earth Science conceptual understanding.

**Keywords:** Science Process Skills, inquiry-based STEAM, learning packet, earth science

## INTRODUCTION

The Science Curriculum centers around scientific concepts that are considered as the foundation of scientific knowledge. These concepts permit us to draw suitable conclusions about the individuals that we encounter in our daily lives. Despite the importance of scientific concepts, learners confront challenges in obtaining these concepts, specifically in elementary years (Barantes & Tamoria, 2021). Results from the 2020 to 2024 National Achievement Test (NAT) for science generally indicate "low proficient" performance in most regions and schools show "low proficient" performance. For instance, Ojastro et al. (2025) reported that in 2024 NAT, the mean percentage score (MPS) for science in one region of the Philippines was 32.03, below the national average of 34.05. Thi trend is reflected in other regions as well. These results suggest that Filipino learners still have low retention of concepts, limited reasoning and logical skills, and poor communication skills as they cannot express ideas or explanations in their own words, as highlighted by SEI-DOST and UP NISMED (2011).

To mitigate such lack of scientific knowledge, learners must acquire the fundamental abilities such as observation, inquiry, prediction, basic experimental skills, and etc. These foundational skills are called science process skills (SPS). Science Process Skills are vital for learners as they form the bedrock for scientific investigation and exploration. Also, it will lead learners to gain interest in learning how to think and show them

how important it is to teach process skills (Batisla-Ong, 2021). Despite its crucial importance, there are still reports regarding the low proficiency in learners SPS. In 2019, according to the international assessment conducted Trends in International Mathematics and Science Study (TIMSS), 13% of Filipino learners are at the lowest level of the TIMSS four-level scale, indicating that they had a limited understanding of science concepts and limited understanding of foundational science facts, while the remaining 87% did not even reach this level. Also, TIMSS indicate that learners' SPS proficiency across many countries remains unsatisfactory (Mullis et al., 2020) including in the Philippines.

The low proficiency of elementary pupils in science process skills can largely be attributed to the lack of emphasis on these skills in classrooms. Widodo and Budijastuti (2020) found out that teachers often prioritize teaching theoretical concepts over practical science process skills, which leads to this approach limits learners' opportunities to actively develop these essential skills. This finding is supported by Villareas (2024), who noted that learner's proficiency in SPS did not meet expectations, except for measuring and classifying skills, which are satisfactory. The TIMSS framework identifies Life Science, Physical Science, and Earth Science as key content domains, with Earth Science ranking lowest scored. In the current Grade 5 MELCS curriculum, Earth Science is allotted less instructional time compared to other science areas. Additionally, reports from Region IV-A shows that Earth Science, taught in the fourth quarter, has the least mastered competencies among other quarters.

Given these challenges, there is a need for a new approach that is well suited to enhancing the learners' SPS. Inquiry-based learning (IBL) and STEAM (Science, Technology, Engineering, Arts, and Mathematics) approach are two promising strategies. IBL approach is a powerful learning tool that supports the development of scientific knowledge, process skills, and scientific thinking, and studies have shown its significant positive effect on learners' SPS (Şahintepe et al., 2020; Mulyeni et al., 2019). This proves that this approach makes it easier for students to perceive the real world and provides opportunities for them to use all kinds of science concepts. On the other hand, the STEAM approach is derived from STEM education aimed to cultivate critical thinking and problem-solving abilities (Henriksen et al., 2019; Liao, 2019). Incorporating artistic elements into STEAM allows learners to explore creativity and expression—enhancing engagement with learning processes (Henriksen et al., 2019). Also, this approach offers a promising avenue by fostering curiosity and encouraging inquiry-based learning practices. Results from the study of Perez et al., (2025), found that inquiry-based STEAM teaching materials improved students' conceptual understanding. Also, results from the study of Meepat et al. (2024), revealed that STEAM Education learning packages have improved Grade 5 learners' science process skills.

**The objectives of this study are:**

1. To determine the teaching - learning materials that teachers used in teaching earth science 5;
2. To assess the SPS level of the learners before the intervention.

This paper provides basic information about the SPS proficiency of Grade 5 learners and teaching insights on teaching Earth Science. In addition, this study is used to be a guide for crafting an Inquiry-based STEAM Learning Packet that will be used in learning Earth Science topics. This is a self-directed learning material to enhance the learner's science process skills.

## METHODS

### Research Design

This study follows a mixed-method research design that combines quantitative and qualitative approaches. Using survey questionnaires for Grade 5 teachers and science process skills inventory test for Grade 5 learners who are currently enrolled in school year 2024-2025, a comprehensive needs assessment survey was carried out, which will provide both quantitative and qualitative data. The primary objectives are the following:

1. to assess the existing learning materials that teachers used in teaching Earth Science;

2. to determine the least mastered competency in Earth Science 5; and

3. determine the SPS of Grade 5 learners.

The survey's findings will serve as a benchmark to gain valuable information for relevance and as a basis for developing a learning material in teaching Earth Science.

**Research Instrument**

Questionnaires administered for needs assessment surveys were adapted and modified from previous studies. A needs assessment survey questionnaire was used in the study of Guiritan et al. (2024), and Science Process Skills Inventory (SPSI) was used in the study of Bourdeau & Arnold (2009). Both questionnaires were modified based on the appropriateness of the study's objectives. These questionnaires were subjected to face validation by the researcher's panel members to guarantee that the surveys would obtain relevant information. Participants were invited to answer the survey questionnaires. For the Grade 5 Science teachers, the questionnaires were administered through Google Forms to facilitate easy dissemination throughout the different districts of the Division of Iligan City.

**Research Participants**

The research participants of the study were forty (40) Grade 5 learners from one public elementary school in Iligan City, who were selected through purposive sampling. The inclusion criteria for the subjects were as follows:
(a) currently enrolled as a Grade 5 learners in school year 2024-2025;

(b) with at least 90% attendance in science classes;

(c) had not undergone any formal lessons on the identified least mastered competency/ies; and

(d) willing to participate in the research study, with consent secured from their parents or guardians.

In addition, were Grade 5 Science teachers teaching Science 5 in randomly selected public schools in the Division of Iligan City. They served as key informants of the study, with the aim of gathering information regarding the existing teaching-learning materials in Earth Science, the least mastered competency in Earth Science 5, and their Grade 5 learners' science process skills. The following were the criteria for the selection of the key informants:

(a) currently employed as public teachers handling Grade 5 Science;

(b) with five or more years in the teaching service; and

(c) had been using any forms of teaching-learning materials in teaching science.

**Data Analysis**

To get significant results from the gathered data, a variety of analysis techniques and statistical tools were used in the data analysis process. To determine emerging patterns and themes, thematic analysis was utilized to analyze and evaluate the qualitative data gathered throughout the needs assessment. Statistical tests such as mean, frequency counts, percentage were used to describe utterance of the responses. A rating scale used to measure opinions of the respondents.

## RESULTS AND DISCUSSION

**Needs Assessment for Science Teachers and Learners' Science Process Skills**

Important and pertinent data regarding the existing teaching-learning materials, learner's SPS level, least mastered competency in Earth Science and Problem in teaching earth science topics of Grade 5 teachers were gathered via the needs assessment that was carried out through Google form. This part covers a variety of subjects (see Table 1). When taken as a whole, these themes give readers and suggest ways that earth science education and learners' SPS might be improved.

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Table 1. Summary of Responses of the Needs Assessment for Science Teachers

| Themes | Codes | Key Informant Responses |
|---|---|---|
| Teaching Experience | Years of Teaching | *"5-7 years" (KI1, KI4, KI5, KI7, KI8) "More than 7 years" (KI2, KI3, KI6, KI9, K10)* |

Con't of Table 1

| | | |
|---|---|---|
| Learning Competency | Least Mastered | *"Investigate extent of soil erosion on the community and its effects on living things" (KI8, KI10)*<br><br>*"Characteristics of Weather Disturbances" (KI6)*<br><br>*"Infer the patterns in the changes in the appearance of the moon and its misconceptions" (KI1, KI2, KI3, KI5,KI6, KI7, KI9)*<br><br>*"Identify star patterns that can be seen at the particular place" (KI3,KI4)* |
| Problem Faced | Comprehension difficulties | *"The learners find difficulties in constructing their own sentences when explaining" (KI1)*<br><br>*"The learners have difficulty explaining the concept" (KI2)*<br><br>*"Lack of comprehension of learners" (KI6)*<br><br>*"Lack of comprehension children now a days are passive in terms of academic" (KI3)*<br><br>*"Learners tend to mix the patterns and its concept" (KI5, K10)*<br><br>*"misconceptions about scientific concepts" (KI7)*<br><br>*"Lack of retention" (KI9)*<br><br>*"Learners can't memorize complex, can't develop high levels output" (KI8)* |
| | Inadequate learning materials | *"Not enough learning resources like books, usually rely on youtube videos" (KI4)* |
| | Academic Attitude | *"Lack of study habits. children now a days are passive in terms of academic" (KI3)* |
| Instructional Material Used | Teacher-directed Instruction | *"Lecture" (KI1, KI2, KI3, KI4, KI5, KI6, KI10)*<br><br>*"Textbooks" (KI, KI2, KI3, KI6, KI7, KI8)*<br><br>*"Online resources like videos, virtual labs, simulation, etc." (KI1, KI2, KI3, KI4, KI5, KI6, KI7)* |
| | Student-directed learning | *"Group Discussion" (KI2, KI3, KI5, KI7, KI8, KI9)*<br><br>*"Worksheets" (KI1, KI3, KI5, KI7, KI9)* |

| | | |
|---|---|---|
| | | *"Hands-on experiments" (KI3, KI4, KI9)* |
| Importance of SPS | Mastery in Science Concepts | *"These skills are important in teaching earth science for them to truly understand the lessons" (KI1)*<br><br>*"Process skills are essential in teaching science" (KI3)*<br><br>*"It is very important. they need SPS to gain mastery in science concepts"(KI2)*<br><br>*"Very significant since these are the basic skills in learning the Science concepts and ideas" (KI5, KI8, KI9)* |
| | Development of critical thinking and problem solving skills | *"Students learn to ask questions, analyze evidence and draw conclusions based on observation" (KI4)*<br><br>*"Develop the critical thinking orb learners" (KI6)*<br><br>*"By developing these science process skills, students not only gain a better understanding of Earth Science but also build problem-solving abilities that they can apply in future scientific inquiries and daily life" (KI7)* |
| Student's Science Process Skills | SPS Level | *"4" (KI1, KI5)*<br><br>*"3" (KI2, KI4, KI7, KI9)*<br><br>*"2" (KI3, KI6, KI8, KI10)* |
| Openness on the use of IB-STEAM LearningPacket | Undecided | *"not so" (KI5)*<br><br>*"Honestly, i don't know yet Because I'm not familiar about it" (KI1)* |

Con't of Table 1

| | |
|---|---|
| Skills Development | *"To facilitate learners' skills development and concepts" (KI9)*<br><br>*"Yes, it develops the ff. Interdisciplinary approach, Problem solving and critical thinking, incorporating technology, creative and design and last engagement and motivation" (KI6)* |
| Mastery of the Science Concepts | *"Surely if its will suit to mastery in learning earth science" (KI2)*<br><br>*"Yes, in order for the learners to understand the concept in all learning skills" (KI3)*<br><br>*"Yes, it will serve as a step by step guide in teaching science" KI4)* |

Table 1 shows the summary of responses of the teachers in the needs assessment. In teaching experience, it shows that 50% of the key informants are more than 7 years in the teaching service. According to the MELCS by DepEd, Earth Science 5 has five learning competencies with results revealing a systemic challenge in mastering Earth Science among Grade 5 learners, with 70% of the key informants identifying the competency "infer the patterns in the changes in the appearance of the moon and its misconceptions" as the least mastered competency. Key informants added that this is due to persistent misconceptions and poor retention of the learners. This aligns with the national and international trends: TIMSS (2019) found only 13% of Filipino learners achieve science proficiency. This supports the claim of Syahputra et al. (2022) that learners' inability to comprehend topics in science lessons and their perception of learning science as extremely tough are the signs

of the causes where learners have poor retention on the topic. Additionally, SEI-DOST & UP NISMED (2011) attributed such gaps to weak reasoning and communication skills. This refers to key informants who reported learners struggling to articulate explanations (K11, K12) or retain or mix abstract concepts (KI5, K10).

Furthermore, the results show that 70% of the teachers relied on a teacher-centered approach in teaching rather than student-directed instruction. Teacher-centered approaches (TCAs) are increasingly seen as misaligned with science education goals and more emphasis is put more on learner-centered learning approaches to support learners (Kambeyo & Csapó, 2019). Current pedagogical reliance on lectures (100% usage) and outdated textbooks exacerbates these issues, as passive methods fail to cultivate scientific literacy or SPS such as hypothesis testing and data analysis. This aligns with the pattern critiqued by Widodo & Budijastuti (2020) as prioritizing rote memorization over inquiry. It becomes apparent that conventional passive teaching methods may not yield desired results. This is an old struggle in learning science but still exists to this day. A relevant claim by Nuraini & Abidin (2020) also identify that shortage of books that meet learners' requirements, as well as barriers created by learners to themselves, such as lack of desire an excitement for learning and lack of reading comprehension could justify teachers claim of not having enough resources like books (K14) and *"Lack of study habits.. children Now a days are passive in terms of academic"* (KI3).

Compounding these challenges, 83% of teachers rated learners' SPS at Levels 2-3 (partial mastery) description, with deficiencies in advanced skills like experimentation and inference. This reflects TIMSS findings that 87% of Filipino learners lack foundational scientific literacy (Mullis et al, 2020), underscoring a disconnect between curriculum delivery and science process skills development. Due to insufficient focus on enhancing learners' science process skills as claimed by Muliawan (2020), the development of science process skills in the learning process is rarely done, due to the teachers' limited use of student-centered activities such as conducting experiments and self-directed activities.

Despite this, teachers still highly recognize science process skills as critical for conceptual mastery in learning earth science (K11, K15, K18). Science education focuses not only on knowledge and thinking, but also focuses on other dimensions, such as the learning skills used (Duda et al., 2019). In addition, the teachers emphasized that science process skills (SPS) is critical for developing learners' problem-solving and critical thinking skills, which are foundational to science education. In the study of Derilo (2019), he mentioned that learners who utilize SPS have a higher tendency to achieve higher compared to those who did not utilize such skills. Emphasizing reasoning skills enables learners to tackle problems analytically, leading to higher success rate.

Despite these findings, 40% express hesitancy toward adopting STEAM approaches due to unfamiliarity (K11, K15) - a barrier linked to insufficient training and resource constraints, as noted in Henriksen et al., (2019) STEAM Framework analysis. The proposed inquiry-based STEAM learning packet directly addresses these gaps by integrating arts-driven activities (e.g., a structured IBL activities like moon phase modelling) to reduce abstraction barriers. This was a strategy validated by Liao (2019) STEAM interventions, from which the result shows 22-35% SPS gains in ASEAN contexts.

Table 2. Summary of the Responses of Learner's on Science Process Skills Inventory

| Criterion | n | frequency | | | | Description |
|---|---|---|---|---|---|---|
| | | A | B | C | D | |
| 1. I can use my senses to gather information. | 40 | 3 | **21** | 9 | 7 | sometimes |
| 2. I can explain phenomena based on the given data. | 40 | 8 | **19** | 10 | 3 | sometimes |
| 3. I can share findings through words/illustrations and explain it to others. | 40 | 9 | **14** | 13 | 4 | sometimes |
| 4. I can predict the possible outcomes. | 40 | 14 | **18** | 7 | 1 | sometimes |

| | | | | | | |
|---|---|---|---|---|---|---|
| 5. I can draw conclusions from the given information. | 40 | **19** | 11 | 7 | 1 | never |
| 6. I can design a scientific procedure to answer a question. | 40 | 13 | **18** | 7 | 2 | sometimes |
| 7. I can communicate a scientific procedure to others. | 40 | **19** | 13 | 6 | 2 | sometimes |
| 8. I can record and estimate data accurately | 40 | **19** | 14 | 7 | 0 | never |
| 9. I can identify whether the statements are facts or made-up claims. | 40 | **17** | 16 | 5 | 2 | never |
| 10. I can analyze the result of a scientific investigation. | 40 | **18** | 16 | 3 | 3 | never |
| **Overall** | **40** | | | | | |

Legend: A - (Never), B - (Sometimes), C - (Usually), D - (Always)

Table 2 presents the results of learners' self-assessment using the Science Process Skills Inventory (SPSI), highlighting significant weaknesses in several areas. For Criterion 5 (drawing conclusions), 8(recording/estimating data), 9 (identifying facts vs. claims), and 10 (analyzing results) learners consistently responded "Never" (see table 2 for frequency), indicating a lack of proficiency in higher-order science process skills. The inability to draw conclusions from given information supports findings of SEI-DOST and NISMED (2011), which revealed that Filipino learners often struggle with reasoning and logical skills. This also hinders their capability to make evidence-based inferences.

Furthermore, the difficulty in distinguishing facts from made-up claims is particularly concerning for scientific literacy, as it suggests a deficiency in critical thinking-an essential component of scientific inquiry (Henriksen et al., 2019). For the remaining criteria, learners most often responded "Sometimes". This suggests that while some foundational science process skills are present, these skills are not consistently applied or fully developed. Such partial mastery may reflect the overemphasis on science concepts in classrooms, as noted by Widodo and Budijastuti (2020), which limits opportunities for active engagement and skill development or enhancement.

Additionally, the results indicate that learners may be able to use their senses to gather information or explain phenomena to some extent, but they still struggle to design and communicate scientific procedures effectively. This likely contributes to their not meeting the SPS proficiency expectations, as measured by the inventory.

## CONCLUSION AND RECOMMENDATION

The comprehensive needs assessment of Grade 5 teachers and learners revealed key problems, expectations, and discrepancies related to teaching and learning Earth Science 5. Notably, the study found that "inferring the patterns in the changes in the appearance of the moon and its misconceptions" is the least mastered competency, primarily due to lack of resources and persistent misunderstanding among learners. In addition, teachers reported that learners' science process skills only partially met expectations. However, this assessment contrasts with learners' self-evaluations, which indicate an even lower proficiency in higher-order SPS.

Thus, based on the need assessment results, the study suggests that educators should focus on implementing learning approaches embedded with self-directed science activities. These approaches allow learners to actively use and develop their science process skills, which can lead to a higher level of conceptual understanding and mastery of Earth Science topics. Developing STEAM-based learning materials for Earth Science 5 is recommended, as such resources can address the persistent gaps in learners' SPS and content mastery. This aligns with broader findings in Philippine science education, where challenges such as low retention of concepts, insufficient instructional materials, and a predominance in both national and international assessments. Shifting toward more learner-centered, inquiry-based, and integrated approaches like STEAM may help address these longstanding issues and improve both science process skills and mastery of concepts among Filipino learners.

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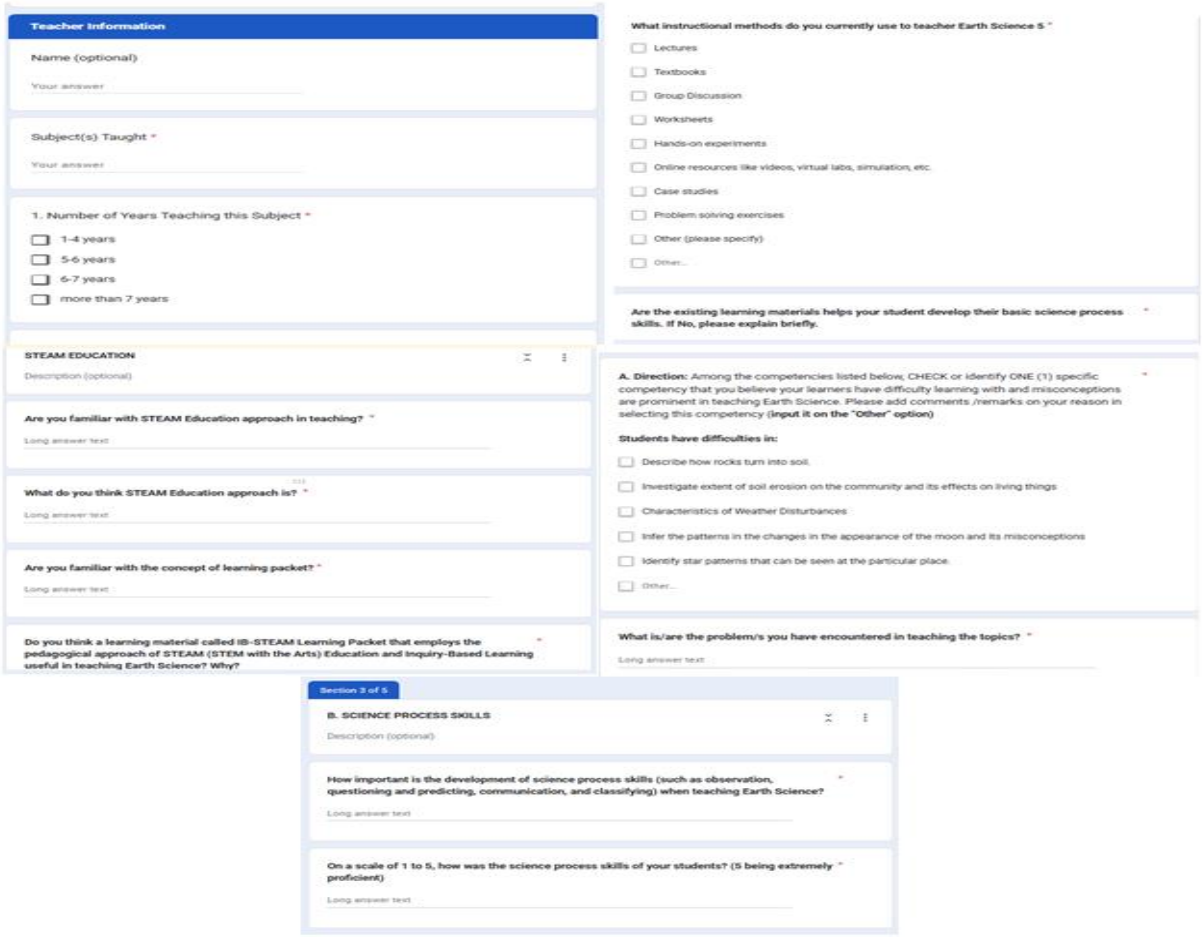
# APPENDIX A

**Needs Assessment Survey Questionnaire for Science Teachers (Google Form)**




# APPENDIX B

**Science Process Skills Inventory (SPSI)**

**Student's Code: _____**
**Date: _____**

**Direction: Read the statement carefully. Check (/) the best answer from the options provided.**

| Criterion | A Never | B Sometimes | C Usually | D Always |
|---|---|---|---|---|
| 1. I can use my senses to gather information. | | | | |
| 2. I can explain phenomena based on the given data. | | | | |
| 3. I can share findings through words/illustrations and explain it to others. | | | | |
| 4. I can predict the possible outcomes. | | | | |
| 5. I can draw conclusions from the given information. | | | | |

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| | | | | |
|---|---|---|---|---|
| 6. I can design a scientific procedure to answer a question. | | | | |
| 7. I can communicate a scientific procedure to others. | | | | |
| 8. I can record and estimate data accurately | | | | |
| 9. I can identify whether the statements are facts or made-up claims. | | | | |
| 10. I can analyze the result of a scientific investigation. | | | | |