**Renaissance Teacher Work Sample Consortium**

***A Teacher Work Sample Exemplar***

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Grade Level: 3rd

Subject: Science

Topic: Earth Materials – Mock Rocks

# Teacher Work Sample

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**3rd Grade, Everson Elementary School**

**FOSS Science – Earth Materials *Mock Rocks***

**Western Washington University, Woodring College of Education**
**Elementary Education, Course 471**

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# CONTEXTUAL FACTORS

## Community, district and school factors

Everson Elementary School is part of a small rural community of about 2,000 people. This K-5 school is surrounded by a fifteen-mile radius of corn fields, raspberry cultivation and dairy farms, and it lies in the shadow of Mt. Baker at the northwestern edge of Washington State. Due to its rural nature, the surrounding community is generally low- to middle-class, with many people working in the local agriculture industry or commuting to the relatively larger town of Bellingham, just fifteen miles west. 55% of the students at the school receive free or reduced price meals.

The three principal races in the community are White (76.4%), Hispanic (18.3%) and American Indian (3.8%). These populations are represented very differently within Everson Elementary's 245-student population, however. 46.5% of students are White; 17.6% of students are American Indian; and approximately 34% of Everson Elementary's students are Hispanic. The languages spoken in this 23% transitional bilingual school are English and Spanish, and one family speaks Punjabi. There is characteristically high mobility in many of the Hispanic families in this rural area, due to the seasonal nature of their work in agriculture. Nearly 9% of Everson Elementary families are migrants. For this reason, the Hispanic student population within the school fluctuates throughout the school year.

## Classroom factors

My third grade classroom has nineteen students in it. Their desks are situated in clusters of four in the center of the classroom. The room is well supplied with a rich array of resources, such as five underused computers, a document camera, a microphone system, math manipulatives, science and math curriculum kits and a well stocked student library. There are three large work tables and ample floor space throughout.

Science instruction occurs in the morning on Mondays and Wednesdays, usually for forty to sixty minutes. Students have been working with assigned science partners that are, in general, academically homogeneous as well as the same gender as the student. The only other subject in which students are assigned to academically homogeneous groups is literacy, specifically during book club

reading. Otherwise, students are usually free to work in small groups or pairs of their choice throughout the room.

Parental and community involvement within the classroom is evident in many forms. One parent volunteers on Tuesdays to do miscellaneous tasks for the teacher, and one elderly community member volunteers on Wednesdays to do the same. There is regular parental assistance with homework for some of the students who struggle academically or who cannot work efficiently, and many of the parents are present at school events or contribute to the class's learning projects.

**Student Characteristics**

My third grade class has seven boys and twelve girls, for a total of nineteen students. Of these nineteen students in my class, there are a total of seven Hispanic students (37%), one American Indian student (5%) and eleven White students (58%). During the first two months of the school year there was a notable influx of students in and out of the classroom roster. Three Hispanic students came new to the class after about two weeks, and three Hispanic students have since moved away (one to neighboring Bellingham, and two to the state of Texas). Many Everson Elementary staff forecast the mid-year migratory return of the two of the students whose families moved to Texas, since this migration pattern is typical for many Hispanic families in the area.

There are three students in the class who receive special education services. Two of these students leave the classroom during science time for specialized instruction. The one other student receiving special education who stays in the classroom during science is also an English language learner (ELL). There are three other ELL students in the classroom (for a total of four) and two native English speakers in the class that receive some light speech assistance.

**Instructional Implications**

Classroom space: The availability of space encourages diverse learning settings, such as whole-class instruction at the carpet or at their desks, group demonstrations at work tables, collaborative group work or individual work around the room or at desk clusters, and ease of movement between all of these settings. The space also allows for efficient set-up of and access to the many instructional materials used in science.

Low-income status of many students: I must be sure to make science instruction accessible to students who may not have a wide array of experiences outside of daily life in a rural community. My examples must be concrete and explicit, and I must not make uninformed inferences about how much students know about scientific concepts or occurrences in nature.

Migrant students: Since the school is uncertain if or when our migrant students will return from Texas, it will be important to always prepare extra materials, such as science notebooks, in the case that our class population again increases. Furthermore, these extra materials can serve as classroom back-ups, if any materials are broken or lost.

ELL students and students receiving speech services: In my instructional planning I will provide regular opportunities for peer discussion. I will model and repeat over time the ways in which to speak about science, so that students needing language support have an adequate scaffold to express their thoughts. Since I am bilingual in speaking, reading and writing Spanish, I will always be available to rephrase my instruction in Spanish, translate assignments and instructions to Spanish, or scribe in English what my ELL students are thinking in Spanish, so that they get the needed linguistic support to succeed in science. In addition, the Spanish-speaking students' and my connections to the Spanish language will provide opportunities to discuss the root meanings of the many Latin-based words used in science, since those Latin roots are often found in Spanish words, too. This will boost our ELLs' sense of competence, since they'll be contributing to valuable class learning by sharing their unique linguistic knowledge.

American Indian culture: The FOSS Earth Materials Science Kit provides a story that can be read about an American Indian myth of the origin of rocks in the plains. This will spark discussion about Native origin myths, potentially tapping into some of the myths our American Indian student (or other students) may know. This reading and discussion will lead into the students' own mythical writing of the origin of rocks.

Community and parental involvement: Since the school and the classroom itself are open to community and parental involvement, there is the opportunity to identify a parent or community geologist who can visit the class to share about rocks, minerals and real-life work with earth materials.

# LEARNING GOALS

These learning goals and essential questions will guide the planning, delivery and assessment of the Full Option Science System (FOSS) Earth Materials *Mock Rocks* rocks and minerals mini-unit. They are aligned with Washington State Essential Academic Learning Requirements (EALRs), and each goal emphasizes specific Bloom's Taxonomy learning domains.

**Essential Question**: How do observation, physical action and communication help us to understand rocks and minerals?

**Learning Goal 1 (LG1)**: The student will explain in verbal and written communication that rocks are composed of minerals, and minerals cannot be physically separated into other materials.

- Science EALR 1 – Systems: The student knows and applies scientific concepts and principles to understand the properties, structures and changes in physical, earth/space and living systems.
    - Component 1.2 – Structures: Understand how components, structures, organizations and interconnections describe systems.
        - Grade-level Expectation 1.2.3 – Structure of Matter: Know that substances are made of small particles.

- Bloom learning domain emphasized: *Cognitive Comprehension*. The student will be able to explain and interpret in written and verbal modes the fact that rocks are composed of various types of minerals that cannot be divided into other materials. The student will be able to transfer his/her experience in breaking up mock rocks and isolating the component mock minerals to a general understanding that real rocks are composed of minerals.

- Appropriateness of LG1: This goal addresses the skill of communicating one's thinking about scientific concepts to others, which aids in the development of expository speech, writing about realistic concepts and distinguishing between fact and opinion. Understanding that material parts make up a whole is essential pre-requisite knowledge for learning about the origins and types of rocks and about matter, molecular properties, elements, and chemical compounds.

**Learning Goal 2 (LG2)**: The student will predict, collect, observe, organize, describe and record physical data about rocks, minerals and experimental events.

- Science EALR 2 – Inquiry: The student knows and applies the skills, processes and nature of scientific inquiry.
    - Component 2.1 – Investigating Systems: Develop the knowledge and skills necessary to do scientific inquiry.
        - Grade-level Expectation 2.1.5 – Communicating: Understand how to report investigations and explanations of objects, events, systems and processes.

- Bloom learning domain emphasized: *Cognitive Analysis*. The student will produce explicit diagrams, illustrations and writing to convey predictions, observations and inferences derived from evidence.

- Appropriateness of LG2: This goal incorporates kinesthetic, visual-spatial and linguistic learning, so that every student is able to succeed in some or all of the steps of the data-collection and journaling process. For example, students who struggle in speaking or writing English can still actively predict, observe, collect, describe and illustrate data while having the written output supported or scribed by the teacher. This learning goal also ensures that the students experience and record tangible, observable, sequential evidence in their science journals. This is important, because the students are still in the concrete operations level of cognitive development.

**Learning Goal 3 (LG3)**: The student will use geological tools of inquiry to carefully observe, and knowledgeably separate and isolate earth materials following established procedures.

- Science EALR 2 – Inquiry: The student knows and applies the skills, processes and nature of scientific inquiry.
    - Component 2.1 – Investigating Systems: Develop the knowledge and skills necessary to do scientific inquiry.
        - Grade-level Expectation 2.1.2 – Planning and Conducting Safe Investigations: Understand how to plan and conduct simple investigations following all safety rules.

- Bloom learning domains emphasized: *Cognitive Application* and *Psychomotor Mechanism*. The student will use and manipulate simple to complex geologists' tools, such as a simplified rock pick or an adjustable microscope, to gather information about earth materials.

- Appropriateness of LG3: This goal nurtures the development of visual-spatial competence and effective decision-making by giving students meaningful tasks that must be done through the correct and coordinated use of the senses and the use tools that enhance the senses. Students must learn how to correctly and safely use these simple tools of scientific inquiry, so that they can move on to more complex tools in future science units.

**Learning Goal 4 (LG4)**: The student will use written communication to demonstrate real life connections to rocks, minerals and geology.

- Science EALR 3 – Application: The student knows and applies science concepts and skills to develop solutions to human problems in societal contexts.
    - Component 3.2 – Science, Technology and Society: Analyze how science and technology are human endeavors, interrelated to each other, society, the workplace and the environment.
        - Grade-level Expectation 3.2.3 – Careers and Occupations: Understand how knowledge and skills of science, mathematics and technology are used in common occupations.
- Writing EALR 2: The student writes in a variety of forms for different audiences and purposes.
    - Component 2.1: Adapts writing for a variety of audiences.
        - Grade-level Expectation 2.1.1: Understands that writing changes for different audiences.

- Bloom learning domain emphasized: *Cognitive Application*. The student will produce writing that applies the geological experiences and reading from the classroom into new contexts for the purpose of communicating with real people in the field of geology.

- Appropriateness of LG4: This goal provides students with an authentic, meaningful connection between classroom learning and work that goes on in the professional community. Such a powerful connection results in very engaged learners and sustained learning long beyond this Earth Materials unit – for all levels of learners. This real life connection will help struggling writers to be motivated about writing and to feel the sense of achievement after experiencing the positive effects that writing can produce. This experience will give ELLs a language-rich, meaningful setting to access the learning and experiment with language themselves. Finally, this real life experience will animate the higher level learners to seek out additional resources about geology than what will be provided for the general class.

# ASSESSMENT PLAN

**Overview**

I will evaluate student learning using a range of assessments, which will monitor the students' progress toward the four learning goals established for this rocks and minerals mini-unit. Each learning goal has a set of assessments that I intentionally aligned with the goal's objective as well as the goal's Bloom learning domain, so that the assessments are valid measures of the students' knowledge based on the types and levels of learning they did. The alignment between the learning goals and assessments are delineated in the *Assessment Plan Matrix*, which follows this narrative.

I also designed a variety of adaptations that will be used during this unit's instruction and assessment to ensure that all students are able to fully access the content and demonstrate their learning of the same. The adaptations for each learning goal and assessment can also be found in the *Assessment Plan Matrix*. I developed each adaptation by examining the learning goal's type of assessment and identifying where particular students may need additional or modified support. I paid close attention to the specified community, school, classroom and student factors from the previous Contextual Factors section of this teacher work sample, in order to carefully address all of the diverse needs in my class. Many of my adaptations are created for one particular student who is an English language learner that also receives special education services. I will abbreviate this student's particular learning needs by simply calling him by the name "Nestor". Where appropriate, I will re-emphasize Nestor's particular learning needs to justify my chosen adaptations for him.

On the following pages is a narrative description of the assessments and evaluation criteria that I will use for each learning goal in this rocks and minerals mini-unit. Additional information about each type of assessment, such as scoring rubrics or observation checklists to be used, can be found in the Appendix at the end of this teacher work sample. I will direct the reader to this Appendix when it is necessary for complete understanding of an assessment.

**Assessment of Learning Goal 1:** *The student will explain in verbal and written communication that rocks are composed of minerals, and minerals cannot be physically separated into other materials.*

This learning goal focuses on the *comprehension* domain of Bloom's learning taxonomy. For this reason, I designed the assessments to call for verbal and written explanation of what rocks and minerals are and how they are different. The pre- post-assessments will consist of a writing prompt that asks students what they currently know about rocks and minerals and what they want to know about them. These written self-assessments will be evaluated on a checklist (see Appendix A) to determine the degree to which the students differentiate between the terms *rock* and *mineral* and the level of experience they have with rocks and minerals. In order to be considered proficient in their knowledge of the difference between rocks and minerals, the student must demonstrate knowledge of three out of the four checklist components. For the pre-assessment, students will also get the opportunity to share their questions about rocks and minerals into a voice recorder. This voice-recording will be used as a prompt in the post-assessment for students to self-evaluate their growth on a rubric (see Appendix B). I will use the results from this rubric strictly for the instructional purpose of gauging their motivation about the subject of rocks and minerals, not for grading purposes. My objective is to have students evaluate themselves at a 3 for at least two components on the self-evaluation rubric.

While students are breaking apart their mock rocks, I will ask probing questions to each set of science partners as a type of formative assessment. I will use a conferencing and anecdotal notes form to evaluate the students' ongoing learning (see Appendix C). The information gleaned from these anecdotal notes will inform me of the understandings and misconceptions that students are forming and/or maintaining while learning about rocks and minerals. As another formative assessment, I will give the students a homework question that asks why a student would liken a "mock rock" to a chocolate chip cookie, prodding students to explain how the "mineral" ingredients of a cookie are similar to the "mineral" ingredients of a mock rock. This homework will be assessed on a rubric based on their depth of understanding that a rock is composed of different minerals (see Appendix D). To demonstrate mid-unit proficiency, the student must score a 2 or higher on this rubric.

In an additional post-assessment, I will give each individual student a small written and oral assessment in which he or she must explain the difference between a rock and a mineral and how the experiments demonstrated the difference between rocks and minerals. I will use a rubric to assess the student's level of understanding (see Appendix E). Students must score a 2 or higher to show proficiency in their understanding of the differences between rocks and minerals.

**Assessment of Learning Goal 2:** *The student will predict, collect, observe, organize, describe and record in a science journal physical data about rocks, minerals and experimental events.*

This learning goal focuses on the *analysis* domain of Bloom's learning taxonomy. For this reason, the assessments designed for this learning goal are based in making predictions, recording observations and making informed conclusions about rocks, minerals and experiments. For the pre- and formative assessments, I will prompt students to list the types of properties they think scientists can observe and compare in different rocks. I will assess their lists with a checklist (see Appendix F). Students must be able to list five out of 10 of the properties on the checklist in order to be considered proficient at understanding rock and mineral properties.

For a very realistic post-assessment, I will give each student a "mystery earth material" that he or she must thoroughly observe and describe in writing using the rock properties learned, so that another student can use those notes to identify which earth material it is. I will assess the students' written observations with the same checklist used for the pre- and post-assessment of the lists of properties, but now I will use it as a tally sheet for how many times a property was used to describe the mystery earth material (see Appendix F). Students must use at least six of the ten properties in their written descriptions to meet the level of proficiency.

In their science journals, the students will record the observations they make about the mock rocks when they are whole and as they are broken apart and mixed with water. I will perform a formative assessment on these journal entries by using a rubric (see Appendix G) that evaluates the degree of sensory detail in their observations, their communication skills, their evidence of understanding the relationship between rocks and minerals, and the number of "minerals" discovered in their mock rocks. The student must receive a 2 or above in at least three rubric components to meet

proficiency in their journal work. In addition to their journal work, I will formatively assess students' work productivity for actively gathering information and collaborating with their science partners during experiments. I will take anecdotal notes on individual students' work productivity to inform my future instruction (see Appendix H).

Students will regularly write predictions about the possible processes for and results of separating out the minerals from a mock rock. I will formatively assess these journal predictions based on a simple rubric of reasonableness and connections to prior understandings (see Appendix I). Students must receive at least a 2 on both components of the rubric to be considered proficient at making scientific predictions.

**Assessment of Learning Goal 3:** *The student will use geological tools of inquiry to carefully observe, and knowledgeably separate and isolate earth materials following established procedures.*

This learning goal focuses on the *application* and *mechanism* domains of Bloom's learning taxonomy. For this reason, the assessments of this learning goal will be based on students' use of geological tools for the purpose of observing and manipulating earth materials. For the pre-assessment, I will observe and take anecdotal notes on individual students' use of a magnifying lens (see Appendix H), assisting those who need support. As a formative assessment, I will also take ongoing anecdotal notes of the manner in which students are using the geological tools to improve their scientific observations and to reach the designated lesson goals (again, see Appendix H).

An additional formative assessment will consist of students working in small, heterogeneous groups with the task of talking through and physically modeling with tools the steps for separating a mock rock into its "mineral" ingredients. The group will also have to clearly explain *why* each step is necessary to find the rock's minerals. I will videotape these small group sessions to review later with a checklist and anecdotal notes form to evaluate each student's strengths and difficulties in describing and modeling the process of separating rock materials (see Appendix J). I will also use the same checklist and anecdotal notes form to evaluate each individual student in a post-assessment one-on-one performance task that closely mirrors the small group task. Each component of the checklist can be scored as "1" (achieved), ".5" (partially achieved) or "0" (not achieved), and the student must receive a

cumulative score on the post-assessment of 7 out of the 11 performance checklist components to be considered proficient.

**Assessment of Learning Goal 4:** *The student will use written communication to demonstrate real life connections to rocks, minerals and geology.*

This learning goal focuses on the *application* domain of Bloom's learning taxonomy. For this reason, I designed the assessments to be realistic written products that apply classroom learning to real life contexts. For the pre-assessment, students will write a letter to one of two semi-fictional characters from a reading to share their reactions and ask questions about a geological study trip that both of the characters are on. This first letter will be a "cold write", in which the students write a letter using a simple prompt: "Focus on one part of the geology trip…ask lots of questions about rocks, and talk about what you have learned about rocks so far!" I will read these first letters using a letter-writing rubric to informally assess the students' initial ability to apply the content they are learning into authentic written communication (see Appendix K).

As a formative assessment, the students will write another letter to one of the two semi-fictional characters from their readings. The students will receive a writing self-evaluation checklist at the beginning of their writing, which will guide them to include the necessary components of a real life letter about geology (see Appendix L). This self-evaluation checklist must be filled out by each student upon completion of his/her letter, also. The checklist is aligned with the components of the letter-writing rubric used in the first writing activity, which I will also use to assess this second letter (see Appendix K). Students must earn a total score of at least an 11 out of 15 points on the rubric's five performance dimensions to be considered proficient at writing a realistic letter about rocks, minerals and geology.

The other formative assessment I will perform is to prompt the pairs of students to write three thoughtful interview questions for a professional geologist who will visit our classroom. The student pairs will again follow the writing self-evaluation checklist to jointly design questions that are thoughtful, interesting, connected to their in-class learning and comprehensible to the reader (see Appendix L). After completion of the three questions, the pairs will assess their questions using that

writing checklist. I will use the "Inquiry" dimension of the letter-writing rubric to assess these partner-generated questions for depth of thinking and connections made (see Appendix K). To meet proficiency in designing effective interview questions for a geologist, the pairs must receive at least a 2 on this inquiry dimension of the letter-writing rubric.

As a post-assessment, I will ask the students to write a thank you letter to the visiting geologist following his/her visit to the class. As in the two preceding writing activities, the students will use the writing self-assessment checklist to guide and evaluate their writing (see Appendix L). I will explain and model the dimensions of an effective thank you letter by reading aloud to the students my own thank you letter for the geologist. My direct modeling will guide the students into this uniquely real-life writing task. To assess the students' thank you letters, I will use the same letter-writing rubric as before, but I will tack on an additional performance dimension that focuses on the students' expression of gratitude (see Appendix M).

# ASSESSMENT PLAN
## Matrix

| Learning Goal | Assessments | Assessment Formats | Adaptations Made |
|---|---|---|---|
| **LG1**: The student will explain in verbal and written communication that rocks are composed of minerals, and minerals cannot be physically separated into other materials. | **Pre-Assessment** | *Self-assessment*: The students will describe in writing and voice-recorded sharing what they already know about rocks and minerals and what they want to learn about the same. Via a checklist, I will assess whether they differentiate between the terms *rock* and *mineral*, how they use each term, and the degree to which they have experience studying these materials. | While the class is writing their self-assessments, I will move to the one ELL student who also receives special education ("Nestor") and prompt him to tell me what he knows about rocks and minerals. I will scribe what he says into his journal. The voice recorder will be an added support for students who need to practice their speech in authentic situations. |
| | **Formative Assessment** | *Conferencing and discussion*: As students are breaking apart their mock rocks with simple rock picks, I will ask each partnership a list of questions about mock rock ingredients to assess their progress toward understanding that rocks are made up of mineral ingredients. I will record their answers to the questions in an anecdotal notes form. I will also take notes of key statements and questions the students make in our all-class follow-up discussion, which we will revisit in later sessions. | When conferencing with student pairs, I will be prepared to translate and explain each question in Spanish for the two ELL students. I will also be prepared to reframe or simplify my questions and to provide response prompts for the two students who have speech difficulties. This will, moreover, provide universal access to learning, since all students will benefit from some form of communication scaffolding. |
| | **Formative Assessment** | *Homework*: As homework, students will write a response about why a student would liken a rock to a chocolate chip cookie. This will prod students to explain how the mineral ingredients of a cookie are similar to the "mineral" ingredients of a mock rock. This homework will be assessed on a rubric, based on depth of understanding communicated in the writing. | I will read the writing prompt aloud in class to the students and discuss what it means before they take it home. This initial support will scaffold the understanding of students who struggle with reading and/or the English language. We will also discuss the prompt as a group when the homework returns. |
| | **Post-Assessment** | *Individual interview*: During the final individual performance assessment of the process for separating and isolating out all rock minerals, I will give each student a small written assessment that asks a) to explain the difference between a rock and a mineral and b) how mixing the rock ingredients with water helped the student to learn more about rocks. I will use a rubric to evaluate the student's degree of understanding about rocks and minerals. | For ELL students, I will read aloud in English or verbally translate to Spanish the questions for this assessment. If the student demonstrates writing difficulties, I will also scribe his/her response. |
| | **Post-Assessment** | *Self-assessment*: The students will re-write what they know and want to know about rocks and minerals. This will be evaluated on the same checklist used for the pre-assessment. The class will listen to the voice-recording from the pre-assessment to self-assess their growth on a rubric. | I will partially scribe and read for Nestor, but I will challenge him to write and read the common, simple science words from the unit. I will verbally give him the self-assessment. |

| Learning Goal | Assessments | Assessment Formats | Adaptations Made |
|---|---|---|---|
| **LG2**: The student will predict, collect, observe, organize, describe and record physical data about rocks, minerals and experimental events. | **Pre-Assessment** | *Property predictions*: I will prompt students to write individual predictions of what types of properties scientists can observe and compare in different rocks. I will assess their predictions in an informal, all-class discussion and in a formal checklist while reading their science journal predictions and the types of observations they make in their first observations of mock rocks. | To guide students into beginning their predictions, I will recite and post a writing prompt (*I predict that...*) that they can use. I will also move about the room showing two example rocks that the students can use to brainstorm ways of observing and comparing rocks. |
| | **Formative Assessment** | *Journal observations*: In their science journals, the students will record the observations they make about the mock rocks when they are whole and as they are broken apart and mixed with water, listing and drawing what "mineral" ingredients they notice. I will assess the journals with a rubric that evaluates the degree of sensory detail included, the level of scientific communication present, the number of "minerals" discovered in the rocks and their overall conclusions following each lesson. | I will scribe for Nestor, and I will also begin to explicitly instruct him on how to record observations on his own in the simple words and decoding schemes that he knows. I designed these journaling activities to have a large amount of sketching, diagramming and writing prompts to ensure that those students who struggle with writing can still be proficient in science. |
| | **Formative Assessment** | *Process predictions*: Students will write predictions and illustrate their thinking about the possible processes for and results of separating out minerals from a mock rock and from a dissolved water mixture. I will assess these predictions based on a simple rubric of reasonableness and connections to prior understandings. | Prior to writing, we will have extensive partner, small group and all-class discussions to make predictions about these scientific processes. This peer oral language practice will scaffold struggling students' thinking, will provide speech practice for students with communication difficulties, and will model English wording for ELLs. |
| | **Formative Assessment** | *Work productivity*: I will observe and take anecdotal notes of each student's process for gathering information and collaborating with his/her science partner. | I will post the procedural steps for experiments, so that students have support in knowing what to do and how to gather needed information. |
| | **Formative Assessment** | *Property inventory*: As done in the pre-assessment, I will prompt the students to write individual lists of the types of properties scientists can observe and compare in different rocks. I will evaluate these responses with the same checklist as before to assess their growth in the quantity and complexity of ideas about observable and comparable rock properties. | I will again show two (different) examples of rocks to prompt students' thinking about rock properties. I will give Nestor specific prompts that we've discussed to get him to begin writing independently. I will also scribe for him, if needed. |
| | **Post-Assessment** | *Recording observations*: I will give each student a "mystery earth material". They must carefully observe and write down as many descriptions about its properties as possible, so that another student can identify which earth material is being described in the writing. I will assess the written observations with the same property checklist used in previous assessments. | I will work individually with Nestor, so that he can speak aloud what he is observing and inferring while I partially scribe for him. I will expect him to write the common content words that he and I have been working on together. |

| Learning Goal | Assessments | Assessment Formats | Adaptations Made |
|---|---|---|---|
| **LG3**: The student will use geological tools of inquiry to knowledgeably observe, separate and isolate earth materials following established procedures. | **Pre-Assessment** | *Initial use of inquiry tool*: The students will be assessed on their initial use of a magnifying lens to observe a mock rock. I will base this assessment on my observation, taking anecdotal notes on the performance of individual students, and assisting those who need support. | Many students will already know how to use a magnifying glass well. I will work to identify the students who need extra support and take them aside as a group to give them special instruction on the use and purpose of a magnifying lens. |
| | **Formative Assessment** | *Work productivity*: I will take anecdotal notes on the manner in which students are using the tools to improve their scientific observations and to reach the designated lesson goal(s). I will also jot down specific actions, phrases and vocabulary the students apply when using the tools, which can be shared and analyzed during all-class discussions. | I will have familiar prompts in mind while observing the students to remind them of ways to best use the tools and for what purpose the tools are being used. These prompts will assure that I am assessing the students' use of the tools when the students themselves are focused.<br><br>In group discussions, I will model many of the actions and phrases that I heard from students while they were working with the tools. This will be especially important with the microscopes, since many low-income students may have limited prior exposure to such equipment. |
| | **Formative Assessment** | *Small group demonstration*: In small, heterogeneous groups, I will present a rock and pose the challenge for students to discuss and decide how to physically model and verbally explain the steps to finding the rock's mineral ingredients. I will video record these small group sessions to review later, using a checklist and anecdotal notes form to evaluate each student's strengths and difficulties with describing and modeling the process of separating rock materials. This checklist will show me student-specific information and class trends. | I will make all of the tools that we used in the previous lessons available, so that the students who struggle with language will have the physical objects present to guide their speech. This is also a universal design tactic, since all students will benefit from having the relevant tools available.<br><br>There will be a speaking protocol, so all students get a time to talk and demonstrate their learning. |
| | **Post-Assessment** | *Performance task*: With one student at a time, I will present a rock and pose the challenge of how to go about scientifically finding the mineral ingredients of it with all of the tools present that we used in the previous lessons (and a few extras). I will also ask many probing questions to assess the student's understanding. The same checklist and anecdotal notes form from the small group formative assessment will be used again to more precisely evaluate the individual's learning. I will compare this assessment with the assessment I made of the student in the small group demonstration from the previous day to check for reliability and consistency in judgment. | As in the small group assessment, I will make all of the relevant tools available to scaffold students' explanation of the steps. This will help all students act out their thinking, which ultimately makes their speaking richer.<br><br>If any Spanish-speaking students are unable to express a phrase or all of their thinking in English, I will prod them to explain it to me in Spanish or by acting it out. |

| Learning Goal | Assessments | Assessment Formats | Adaptations Made |
|---|---|---|---|
| **LG4**: The student will use written communication to demonstrate real life connections to rocks, minerals and geology. | **Pre-Assessment** | *First letter*: Students will write a letter to one of two semi-fictional characters (Teresa or Aunt Rita, from the read-aloud "Written in Stone", in their *FOSS Science Stories* manuals) to share their reactions and ask questions about Teresa's trip with her geologist aunt, Aunt Rita. The students will also explain what they are currently learning about in science and how it is similar to what Teresa and Aunt Rita are doing. I will assess this letter using a letter-writing rubric to informally evaluate how well students apply in-class learning to authentic written communication. | I will write an example response to Aunt Rita, so that students who need additional support with their writing ideas can seek help by reading my letter.<br><br>I will discuss the story with Nestor, the ELL student who also receives special education services, and scribe what he wants to write back to either Teresa or Aunt Rita. |
| | **Formative Assessment** | *Second letter*: Each student will write a second letter to either Aunt Rita or Teresa, asking questions or reflecting about the latest readings and/or about rocks and minerals, and sharing what they are currently learning in science. I will assess this letter with the same letter-writing rubric, and the students will self-assess themselves using a checklist with components similar to the rubric. | I will assign a writing partner to Nestor, so that he can share his thinking with this other person instead of me, the teacher. The two students will compose a letter together, with the partner student being the scriber and Nestor being the illustrator and labeler. |
| | **Formative Assessment** | *Interview questions*: As a class, we will discuss potential interview questions to ask a visiting geologist. Students will then work with science partners to write a list of three questions they have for the visiting geologist. I will assess each group's questions with the "Inquiry" dimension of the letter-writing rubric, and the students will self-assess themselves using the same writing checklist. | I will write students' suggestions for questions or question themes on a chart, so that students can refer back to those ideas when generating their own questions.<br><br>Since students will not have their questions in hand during the geologist's visit (too much of a distraction), I will post the same chart – with additions made after reviewing the students' questions – to help them formulate questions for our visitor. |
| | **Post-Assessment** | *Final letter*: Students will write letters to the geologist who visited the class. The letter will include a thank you from the student, information that the student learned and questions the student has about geology or the geologist's life. I will assess this letter using the same letter-writing rubric, with an additional performance dimension, "Expression of Gratitude", tacked on. The students will assess their writing using the same writing self-assessment checklist. | I will carefully explain the components of a thank you letter. I will also model, read aloud and post my own personal thank you letter for our geologist guest. This will scaffold students' implementation of the required writing structure for the letter.<br>I will scribe for the ELL student who also receives special education. After he is done telling me his letter, he will rewrite the letter in his own handwriting, so that he has a final, personalized product. |

# DESIGN FOR INSTRUCTION

**Results of the Pre-Assessment**

| Student* | Learning Goal 1 | | | Learning Goal 2 | | Learning Goal 3 | Learning Goal 4 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | The student explains that rocks are composed of minerals. (+ or -) | The student explains that minerals cannot be separated into other materials. (+ or -) | The student explains that rocks and minerals are non-living earth materials. (+ or -) | The student makes realistic predictions. (+ or -) | The student records legibly. (+ or -) | The student uses tools confidently, appropriately and with a purpose. (+ or -) | Inquiry (0-3) | Engagement (0-3) | Sharing of Learning (0-3) | Attention to Detail (0-3) | Conventions and Clarity (0-3) | Total Score out of 15 points |
| **Beatriz#** | - | - | + | - | - | - | **0** | **2** | **2** | **2** | **1** | **7** |
| **Brian** | + | - | + | - | - | - | **1** | **2** | **1** | **1** | **2** | **7** |
| **Brisa** | *Student is taken out of the classroom for special education duri2ng science.* | | | | | | | | | | | |
| **Cristal** | +/- | - | + | + | + | + | **3** | **2** | **3** | **1** | **2** | **11** |
| **Danielle** | +/- | - | + | + | + | + | **1** | **3** | **2** | **2** | **3** | **11** |
| **Eddie** | +/- | - | + | + | - | + | **1** | **0** | **0** | **0** | **1** | **2** |
| **Erin** | - | - | + | + | + | + | **1** | **2** | **0** | **2** | **1** | **8** |
| **Henry** | - | - | + | + | - | + | **2** | **3** | **1** | **2** | **1** | **8** |
| **Joshua#** | - | - | - | + | + | - | **1** | **1** | **0** | **1** | **0** | **3** |
| **Katrina** | + | - | + | + | - | - | **3** | **3** | **2** | **2** | **2** | **12** |
| **Mandy#** | + | - | + | + | + | + | **3** | **3** | **2** | **3** | **3** | **14** |
| **Nicole** | + | - | + | + | + | + | **1** | **3** | **1** | **2** | **1** | **8** |
| **Nestor** | - | - | + | + | - | - | **1** | **1** | **2** | **1** | **0** | **5** |
| **Natasha** | - | - | + | + | + | + | **1** | **2** | **2** | **2** | **1** | **8** |
| **Pablito** | *Student is taken out of the classroom for special education during science.* | | | | | | | | | | | |
| **Rebeca** | ab | ab | ab | ab | ab | ab | ab | ab | ab | ab | ab | ab |
| **Stacey** | +/- | - | + | + | + | + | **3** | **2** | **3** | **2** | **3** | **13** |
| **Tomasa#** | - | - | + | - | - | + | **1** | **1** | **0** | **0** | **1** | **3** |
| **Victor#^** | - | - | - | + | + | - | **1** | **2** | **0** | **1** | **2** | **6** |
| **Analysis** | **24%** | **0%** | **82%** | **76%** | **53%** | **59%** | **1.5** | **2** | **1.3** | **1.5** | **1.5** | **7.8** |
| | **Percent that got a +** | | | | | | **Average score** | | | | | |

***Pseudonyms are used for each student's true name, to protect confidentiality.**
**# Students chosen for small group analysis.**
**#^ Student chosen for individual analysis.**

**Analysis of the Pre-Assessment**

From analyzing the pre-assessment data, I notice that the majority of students have very little base knowledge of the relationship between rocks and minerals (LG1). 24% of students understand that minerals are components of rocks, but the other 76% of the class knows only a small amount or nothing at all about minerals. No students understand that minerals are earth materials that cannot be physically separated into other ingredients. Indeed, the fact that minerals can be physically broken but *not* physically separated into other ingredients is a rather abstract concept for third graders, who still think concretely. For this reason, I will have to be very explicit in teaching the students what minerals are and how they relate to rocks (with which they are quite familiar due to regular life experiences). My instructional explicitness will come from providing multiple representations of the rock – mineral relationship through student experiences, role play, physical demonstrations of concepts, repeated discussions and simplifying abstract concepts into familiar components.

The students did well on the predicting-observing-journaling portion of the pre-assessment (LG2). This is most likely due to their prior experience with observing, predicting and journaling in the FOSS Measurement science journal, which directly preceded this Earth Materials unit. I will attempt to incorporate a finite time schedule in to the predictions writing time, since 2/3 of the students receiving a "minus" score (Brian and Tomasa) are the students who are characteristically inattentive and slow to produce. I believe that creating an established, agreed upon time allotment in writing predictions will keep them accountable for their writing output and overall involvement in science.

For those students who demonstrated inappropriate use of tools in the pre-assesement for LG3 – both those students who chose to use them incorrectly and those who don't know how to use them yet, I will take them aside during science time or at some point during the school day to directly instruct them on how to best use the science tools and to discuss with them the purpose of tools (to enhance our senses, so we can observe more). This small-group instruction time will prepare students to be successful in the upcoming science lessons, and it will create a firm understanding between me and the students who chose to inappropriately use the tools that I expect them to use the materials in the manners we discuss. In addition, I will schedule in some time for the students to have the opportunity to use the

magnifying lens outside, so they satisfy their interest in using the tool for their own interests, too. This will help them stay focused in later science lessons when they're expected to observe a designated thing with the lens.

The data trends in the pre-assessment of LG4 show that students need to work on their writing of inquiry and their sharing of learning. These two components of corresponding in writing to others are essential in creating an engaging, personal letter. I believe that the students' inquiry will improve throughout the lesson as we practice a lot of questioning as a group during science time. The formative learning activity of writing questions to our visiting geologist will also help students to improve their skills in writing relevant, thoughtful questions to others about geology. By setting the students up to experience highly engaging, highly educational learning experiences, I think their sharing of what they have learned will also improve in their letters. I designed the student letter-writing self-evaluation form to assist them in developing letters full of inquiry and sharing, since many will still need a structural guide to create a letter that meets proficiency.

**Unit Overview**

| **Lesson Title** | **Learning Goals Addressed** | **Learning Activity to Take Place** | **Assessment to be Given** |
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| Pre-Assessment of Rocks and Minerals; Creation of Science Journals | • LG1 | Initial discussion of the etymology of the word *geology*. Students list in their science journals the things they already know about rocks and minerals and the things they want to know about rocks and minerals. They also record at least one phrase into a voice-recorder elaborating on what they want to know. Students create the covers to their Earth Materials science journals. | Pre-Assessment of LG1: Students self-evaluate their current knowledge and interests about rocks and minerals. |
| LESSON 1: Pre-Assessment of Tools, Properties and Writing; Observing Mock Rocks | • LG2<br>• LG3<br>• LG4 | After I introduce the term *property*, students make initial predictions about the types of properties that scientists can observe in rocks. Students receive their mock rocks and a new classroom tool (the magnifying lens) and observe and record as many detailed properties as possible that they notice about mock rocks using measurement tools and the magnifying lens. | Pre-Assessment of LG2: Students list in their science journals the types of properties geologists can observe in rocks.<br><br>Pre-Assessment of LG3: I observe students' initial use of a magnifying lens to |

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| | | I read-aloud the *Written in Stone* letter in the FOSS Science reader, and students write a letter about rocks and minerals to either Aunt Rita or Teresa.* | enhance observation skills.<br><br>Pre-Assessment of LG4: Students write their first realistic letter to Aunt Rita or Teresa. I informally review these to gauge their ability to write realistic correspondence to another person. |
| LESSON 2: Separating Mock Rocks into Visible Minerals | • LG1<br>• LG2<br>• LG3 | I ask students if they think mock rocks are made out of one or many ingredients. Students write predictions of how to separate out the mock rock ingredients. I challenge them to separate out as many ingredients as possible, introducing students to a new tool, the geologist's rock pick (they will use a smaller version – a nail) and safety goggles. Students break up their mock rocks, sort them into similar ingredient piles and record their observations in their science journals.**<br><br>We discuss our observations, and I introduce the term *mineral*. I challenge students to predict whether the fine sorted material can be separated further into different mineral ingredients. I allow them to suggest possible experiments to find this out, and we gradually get to the idea of mixing the material in water to identify other materials (a similar procedure to what they did in 2nd grade's Pebbles, Sand and Silt unit). We prepare vials of the fine material and water, shake them up and let them sit until the next lesson. | Formative Assessment: I hold conferences and discussions with science partners, while students are breaking apart their mock rocks. I take anecdotal notes on their thinking and their work productivity.<br><br>Formative Assessment: I review later the students' predictions on how to separate out the ingredients of mock rocks and about what they will see in their vials after the fine material and water has sat for a few days. I also evaluate their journal work – sensory detail, communication, evidence-based conclusions and relevant questions.<br><br>Formative Assessment: I send students home with the "cookie problem" situation that they must interpret and connect to rocks and minerals. |
| LESSON 3: Observing Previously Invisible Mock Rock Minerals – Mineral Layers and Salt Crystals; Writing Letter 2 | • LG1<br>• LG2<br>• LG3<br>• LG4 | In their science journals, students draw and write detailed illustrations and observations of what they see in the vials (layers of different mock rock "minerals").<br><br>We discuss as a group what they | Formative Assessment: I move about the room to observe, hold discussions and take anecdotal notes of the students' thinking about rocks minerals, their |

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| | | observed, and I pose the question of whether there could be something *dissolved* in the water. I discuss with the students what it means for something to dissolve, and I connect it to experiences they may have with dissolving something. The students write a prediction of how they could separate the water from another mock rock mineral, if the mineral was dissolved in the water.<br><br>The students share their predictions, and we quickly try some of them (they will likely suggest "straining out" the mineral). Connecting it to puddles on a rainy day that dry up, I pose the process of evaporation to get the mineral out of the water. We set up our evaporation experiment, write and draw predictions of what the result will be and wait for three days to observe the results. They read the FOSS Science reader's *Postcards from the Ledge* and write a second letter to Aunt Rita or Teresa, using the writing self-evaluation checklist as a guide.<br><br>After three days, the students observe the evaporation trays with magnifying lenses and microscopes. They carefully draw the *crystals* that they observe and then identify the type of mineral the crystals are by using a crystal identification sheet.<br><br>The students work with their desk clusters to create a cumulative list of all the mock rock mineral ingredients they have discovered. | work productivity and their use of the geology tools.<br><br><u>Formative Assessment:</u> Students self-evaluate their writing of the second letter to Aunt Rita or Teresa with the self-assessment checklist, and I assess their letter's content and presentation on the letter-writing rubric.<br><br><u>Formative Assessment:</u> I review later the students' predictions on how to separate out a possible dissolved mineral from the water. I also evaluate their journal work – sensory detail, communication, evidence-based conclusions and relevant questions. |
| LESSON 4:<br>Small Group Demonstrations; Formative Assessment of Properties | • LG1<br>• LG2<br>• LG3 | I begin by introducing the formative assessment of properties, in which students must list the types of properties scientists can observe about rocks. While students are working on this, I take the first small group into the hall to record their mock rock mineral separation process.*** | <u>Formative Assessment:</u> I assess the students' responses to properties assessment with the same property checklist used in the pre-assessment. |

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| | | Students read in their FOSS Science reader, if finished with first property post-assessment. When all students are finished with the post-assessment, I introduce the second property post-assessment, the Mystery Earth Material identification challenge. I distribute mystery earth materials and then I take the second small group into the hall to do the same recording.<br><br>Students continue to read in their FOSS Science readers while everyone finishes the Mystery Earth Material writing activity. When students are finished, they get another person's writing and must identify the mystery earth material.<br><br>I take the third small group of students into the hall to record their mock rock separation process, while the other students continue to read FOSS Science reader. | <u>Post-Assessment:</u> I later assess the students' written observations of their mystery earth material with the same checklist used for the pre-assessment and the first post-assessment.<br><br><u>Post-Assessment:</u> Three separate small groups of six heterogeneous students each meet with me for ten minutes to demonstrate their group thinking about the process for separating the "minerals" of mock rocks. I assess each student's thinking with a checklist. |
| Post-Assessment of Individual Performance Tasks; Writing Interview Questions | • LG1<br>• LG3<br>• LG4 | Throughout the school day, I take individual students into the hall for a 5-minute performance interview, in which they must demonstrate their understanding of the mock rock mineral separation process.<br><br>During the designated science portion of the day, I lead a class discussion about some good types of interview questions for a geologist who will visit the class. The students work with their science partners to generate three interview questions for the geologist, using the writing self-evaluation checklist as a guide. | <u>Post-Assessment:</u> I assess each student's performance using the same checklist used in the small group demonstration.<br><br><u>Formative-Assessment:</u> Students self-evaluate their interview questions using the self-assessment checklist, and I assess the interview questions using the "Inquiry" dimension of the letter-writing rubric. |
| Geologist Visitor; Post-Assessment of Rocks and Minerals and Writing Last Letter | • LG1<br>• LG4 | The students will participate in an active discussion and presentation led by a community geologist who visits the class, asking questions and sharing what they know about rocks and minerals.<br><br>The students review their earlier knowledge about rocks and minerals and assess their growth.<br><br>The students write a thank you letter | <u>Post-Assessment:</u> Students assess their personal learning growth with the student self-evaluation rubric.<br><br><u>Post-Assessment:</u> Students self-evaluate their thank you letter with the writing self-evaluation checklist. I evaluate the writing |

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| | | to the geologist, using the writing self-evaluation checklist as a guide. They include what they learned, why they are thankful and any questions they still have. | using the letter-writing rubric with one additional component, expression of gratitude, tacked on. |

***Elaboration of Learning Activity:** ***Read-aloud of <u>Written in Stone</u> and writing a response letter***

This learning activity involves me reading aloud to students a letter included in the FOSS Science Reader. The letter was written by a child around the students' age who was on a trip to study rocks with her geologist aunt. There are also interesting geological pictures and captions included on the pages of this letter. Students then respond to the letter, sharing their reactions to the characters' geological trip, sharing what they have so far learned about rocks and minerals and asking questions about geology. This activity aligns with Learning Goal 4, because students are involved in creating written, realistic communication about rocks and minerals.

I intentionally designed this learning activity to occur early in the unit, so that students would understand that they were going to be learning about and experiencing the geology that is done in real life – not just in the classroom. From reviewing the students' initial knowledge about rocks and minerals (what they wrote in the pre-assessment of LG1), I learned that they had very scattered ideas about what they were going to learn about earth materials. Students were writing about the origins of rocks (from volcanoes; from the moon and outer space), about rock properties (hardness, colors, size and weight; knowing that rocks break into sand; and telling the age from the cracks in the rock), and about the mineral-rock relationship (rocks are made of / have / or *are* minerals; minerals are the different colors on rocks; and diamonds or shiny things are minerals). This read-aloud will focus their scattered knowledge about rocks and minerals, so that they can better anticipate what they will be learning about during this unit. The read-aloud will also clarify or expand upon a majority of their initial conceptions about rocks and minerals, and it will spur group discussion about some of the things they mentioned in their LG1 pre-assessment. The subsequent letter-writing activity will challenge the students to put into clear, written language a more defined (less scattered) set of information about rocks and minerals.

The nature of this reading and letter-writing activity requires no technology for its successful delivery. Although there is a microphone system in the classroom, my voice projects sufficiently to not

need such a device during the read-aloud. To ensure that students get optimal exposure to the Written in Stone letter and pictures in the FOSS Science Reader, I will give each student his/her own reader to follow along while I read the four-page letter.

After students write their response letters to either Aunt Rita (the geologist) or Teresa (the original letter-writer), I will read the letters and assess them by means of a writing rubric that I will also use in subsequent writing activities (see Appendix K). In subsequent writing activities, students will also receive a self-evaluation writing checklist, modeled closely after the teacher rubric, that they will use to guide their writing and assess their final written products (see Appendix L). In this manner, I'll be able to thoroughly track their progress in writing realistic, content-based communication throughout the unit. For this first letter-writing activity, however, students will complete the task without any checklist support, so that I get an unaltered sample of their writing before doing further instruction during later writing tasks.

****Elaboration of Learning Activity: *Separating mock rocks into visible minerals***

I decided to design this student-directed, hands-on learning experience, because, in the pre-assessment of Learning Goal 1, only four students in the class demonstrated some level of understanding that rocks are composed of minerals (or something close to that, such as "minerals are in rocks"). The majority of the class had misconceptions or *no* conception of what minerals were. The design of the activity is based on the constructivist belief that individuals form their knowledge about the world through experience, not through being told what is true. I will provide the students with rock picks and a challenge to find all of the ingredients in a mock rock. Through their extended amount of experimentation time separating, sorting and observing mock rock ingredients, the students themselves will come to the understanding that rocks are made up of various ingredients. Once they've built that concept, I will give them the name of the concept – *minerals*. This approach follows the key tenet of psychological concept formation; I first teach the concept, and only then do I teach the agreed upon word. This student-driven activity relates to Learning Goal 1, because students will become able to verbally explain that rocks are made up of minerals.

The many materials for this activity will include a real geologist's rock pick; nails for students to use as rock picks; goggles to protect their eyes; paper plates to separate and sort mock rock ingredients; large and small magnifying glasses and microscopes to provide students opportunities to observe mock rock "minerals" in diverse ways. I will use two formative assessment tools for this activity, as well. While students are in the process of separating mock rock ingredients, I will use an anecdotal notes sheet to record my observations of the learning and behaviors of each student, which will inform me of any instructional modifications that may be needed in future lessons. I will also use a journal observations rubric (see Appendix G) to later assess students' journal work following the learning activity.

*****Elaboration of Learning Activity: *Small, heterogeneous group demonstration***

This learning activity is meant to review and reinforce students' learning up to this point in the unit. Over the course of ten minutes, the small group of five to six students will get the opportunity to verbally explain and physically demonstrate an expedited version of the process they used to separate out the ingredients of mock rocks. I will also expect them to explain *what* this process taught them and *why* it is important to learn that information. The nature of the small, academically and culturally heterogeneous group will provide the students with the chance to have rich peer discourse about the science they're learning, playing off of one another's thinking in a meaningful way. This type of learning activity relates to Learning Goal 1, since the students will be verbally explaining their knowledge about the rock-mineral relationship, and Learning Goal 3, since they'll be using scientific tools of inquiry to demonstrate the processes for observing and separating earth materials.

This small group performance is a formative precursor to the culminating individual performance assessment that closely follows it. I designed the small group demonstration as an intermediary between the early learning activities and the final individual performance, because the students will need practice moving from a large, all class communication setting to a one-to-one setting that requires complex, concentrated discourse with just one other person. In addition, my informal observations of the discussions surrounding the written pre-assessment of LG1 showed me that most of the students are proficient at participating in large group discussions, but they often appear unsure of how to maintain

academic discussions in small groups and in partnerships. They need more practice in sustaining academic discussions in small groups.

More than just practice, though, these small group demonstrations will be video-taped with a digital video camera. By way of video-taping, I'll be able to later carefully evaluate on a checklist and anecdotal notes form the strengths and weaknesses of each student's participation in the group discussion (see Appendix J). The group's size will be small enough for all students to play an important role but large enough that the discussion will be able to progress at a productive pace. To facilitate a sustained discussion led by the students, I will provide them with all of the inquiry tools used up to that point in the unit as well as physical examples of the mock rock's state at different points during the previous experiments (eg. whole, broken with a rock pick, shaken with water in a vial, and as crystals on an evaporation dish). These materials will give the students tactile support to help them communicate most effectively.

**Use of technology:**

The implementation of this unit employs various means of technology. Much of this technology was acquired through Western Washington University's Science, Mathematics and Technology Education (SMATE) center, which offers a rich array of materials for all types of science instruction, free for university students. I am a firm believer in utilizing community resources, such as university departments and public organizations, to increase my students' access to technology, authentic experience and expert knowledge. By enriching the classroom with geological technology, my students are gaining deeper understandings about rocks, minerals and science, and these understandings are more applicable to the real world.

I will be using a digital voice-recorder at the beginning and end of the unit for students to be able to listen to and reflect on the type of thinking they had at the beginning and end of the unit. I will be using a digital video camera from the university to record students' small group performances, so that I may later replay the video to carefully assess their thinking about the scientific process of separating the "minerals" in mock rocks. Other university tools will include: microscopes, to observe the salt crystals that are extracted from the mock rocks; large and small magnifying lenses, to frequently observe the

mock rock “minerals”; a real geologist’s rock pick, to let the students see and feel what the real-life tool looks like while they use simple nails to break apart their mock rocks; and safety goggles, to both protect their eyes from the mock rock fragments and to give them the experience of working in a geologist’s laboratory wearing the appropriate gear.

As for using technology for the writing goals of the unit, I will utilize the document camera to share student-created examples of good, content-rich letter writing. This will facilitate class-wide discussion about what makes effective science communication and how students can better align their letters with the expectations delineated in the student checklist. I will also have the students utilize the postal service – another form of technology – in order to send their thank-you letters to the visiting geologist.

# INSTRUCTIONAL DECISION-MAKING

**A. Decision to meet the learning needs of the whole class**

At one point during the process of separating the mock rock ingredients into their parts, students shook the material in vials with water. This way, they were able to see how each ingredient settled in the vial to form its own layer. After the creation of layers in the vials, we discussed the layer of water in the vial and what ingredients, if any, could be contained inside the water. Many students suspected that it was pure water, since the water looked clear, and others suspected that it was water with some dirt or sand mixed in. When I posed the question of whether or not something could be *dissolved* in it, my intention was to see which students recognized the word and/or its meaning and which students had never hear the word before. Only four students out of the class of nineteen knew something about dissolving. I then explained what dissolving was and suggested that they pour only the water into small dishes to see what would later happen – would the water dry up and leave any ingredients behind in the dish? The students agreed to this experiment. However, from my discussions with the group and with individuals during the experiment set-up, the students gave uncertain explanations as to why they were doing the experiment in relation to their goal of identifying mock rock "minerals", which was the initial challenge of the unit.

I decided that during the following day, while the water in the dishes continued to evaporate, I would make the concept of *dissolving* more tangible for the students. My goal was to provide the students with authentic, personal experiences with the concept of dissolving and then to guide them into a more meaningful discussion about why their addition of water to the vials and their experiment of drying up the water was related to mock rock "minerals".

First, I asked the students what dissolving was, just to see what they recalled from the previous lesson. Next, I showed them two large jars of warm water. In the first jar, I poured a thawed bag of peas. I then mixed the peas with a spoon and told the students that the jar represented a *mixture* that was not dissolved (since the peas were still visible). For the second jar, I told the students that I would make another mixture, but this one would become a *dissolved mixture*. I poured a bag of sugar into the jar and stirred until the sugar became invisible. At this point, I asked the students why this would be called a

dissolved mixture, guiding their responses to the understanding that the sugar is still there in the jar, but it has become so small and so well mixed into the water that it becomes invisible to our eyes. I decided to provide an example and a non-example in this demonstration, so that students would develop a clear concept of dissolving without any misconceptions.

After that demonstration, I told the students that they were going to act out their own dissolved mixture. I assigned half of the class large blue cards that had "WATER" written on them. These students were the water in the jar. Then, I assigned the other half of the class large orange cards that had "STUDENT" written on them. I prompted the class to mix the WATER with the STUDENTS, so they went through the mixing process by rushing around and bumping into one another. Once "mixed", I asked the class whether or not this looked like a dissolved solution. All students stated "No!" since the STUDENTS were still visible in the mixture. From this response, I asked them what they could do to make their mixture of WATER and STUDENTS more like a dissolved mixture. Little by little, the STUDENTS decided to step out of the mixture away from the WATER. I expected this incorrect response, since it was the most obvious way for the STUDENTS to be unseen in the mixture. I used the example of the sugar and water to highlight their incorrect response and challenge them to find a more creative and realistic way to act out the result of dissolving. One student suggested sinking down to the bottom, so I again pointed the class to the sugar and water dissolved solution, and they saw that such an idea was not the end result of dissolving. I provided more wait time, and then one STUDENT clung onto a WATER, suggesting for all STUDENTS to stick closely to the water, like in the dissolved sugar-water mixture. In response to this, another STUDENT did the same but crunched up and hid behind the WATER, so that he was "invisible". Finally, all of the students did this and were readily explaining why this was an accurate depiction of a dissolved mixture of water and students.

From this dramatic student performance and from my demonstration of dissolving a familiar material in a jar of water, the students formed a much deeper understanding of dissolving and could thereby explain the usefulness of using water to isolate a certain dissolvable mock rock ingredient.

**B. Decision to meet the learning needs of one student**

Nestor is an English language learner who also receives special education services. His most recent score on the Washington Language Proficiency Test II is a Level 2 out of four levels. Scribing for Nestor is an accommodation outlined in his Individualized Education Plan, so I scribed for him on a regular basis in his science journal, recording his spoken observations, predictions and conclusions about rocks, minerals and experiments. I also scribed for him when the class was involved in writing letters to geologists to share what they knew and the questions they had. Nestor demonstrated a strong ability to talk to me or one-on-one with a peer about his observations in science, but he had very slow output when independently writing those observations down in his science journal. When left to write on his own, for example, he would do nothing or doodle on his paper while other students were busy writing about science. When he did have independent writing output, it was often illegible and very simple thoughts – quite in contrast to the rich thoughts he could express orally. I began to realize that, while scribing was a recommended accommodation for Nestor, I needed to help him develop independence in writing and using content vocabulary on his own.

I wanted to create the most optimal instructional adaptation possible for Nestor's learning needs – one that aptly targeted the learning need but included a limited amount of control on the part of the teacher. I chose to approach Nestor's learning needs by first interviewing three individuals with different degrees of knowledge about Nestor himself and about adaptations for students with writing output challenges like his. The head classroom teacher recommended that I continue to scribe for him, since it is in his IEP and since he struggles so much with putting his English words into written form. The director of Everson Elementary's special education department recommended that I begin to explicitly teach Nestor strategies for how to begin writing or putting words down on paper instead of waiting for me to approach him to get him started. I also consulted my instructor of special education at Western Washington University, who suggested that I create a physical instrument that would help Nestor develop ownership, independence and growth in his writing and vocabulary.

From my discussions with these professionals, I decided to create a picture dictionary tool for Nestor (see Appendix N). To create this picture dictionary, I sat with Nestor and helped him to choose

photos of rock and mineral properties and science tools that he thought were most important for his science learning. With my help, Nestor sorted the chosen photos into meaningful piles, matched the photos with their type-written words and then glued them onto blank pages to make the dictionary. I also explicitly modeled and taught him how to use the picture dictionary on his own, so that the tool would scaffold his writing and give him a sense of ownership over his learning. To do this, I first posed a task of writing observations about a rock. I modeled how I could use the picture dictionary to help me choose strong science words for my writing, and I wrote a detailed description about the rock. Next, Nestor and I worked on one together with a different rock. We first discussed our observations of the rock and then thumbed through the dictionary together to find the appropriate words, which Nestor recorded in writing. After this guided task, I gave Nestor a new rock and asked him to record all the observations he could, telling him to use the picture dictionary to help him find good science words to use. I chose to sit near him during this task, so that I was available to help him if he got stuck on this new type of experience. He did require some prompts by me during this relatively independent task. However, I refrained from outright telling him any science vocabulary, so that he got genuine practice in using the picture dictionary on his own.

Since Nestor was previously accustomed to receiving assistance from a scribe, I did not phase scribing out immediately. My intention was to give him adequate practice with the picture dictionary and to gradually teach him strategies to begin to write on his own during this science unit and in the future units of all subjects. As the unit proceeded, I scribed less and less, and I also empowered Nestor to choose new pictures and words to glue into his picture dictionary as his vocabulary skills, writing output and ability to use the dictionary improved.

# ANALYSIS OF STUDENT LEARNING

## A. Group Analysis

### I. Introduction

In this Group Analysis section, I will closely analyze the pre-, formative and post-assessment performances of a group of 5 students to determine the extent to which the students achieved two of my unit's learning goals of particular focus. I chose this group of students with the aim of representing the diverse subgroups of students within the overall classroom population. By focusing in on a representative sample of my class, I will be able to draw conclusions about students' learning that can be roughly generalized to the whole class. Overall, my students include a group of three females and two males, which is proportional to the overall classroom gender demographic (12 female: 7 male). The small group constituents follow:

**Joshua**, is an academically at grade-level American Indian student. He is the only American Indian student in the class, so it is important that I analyze his learning in order to evaluate whether my instruction met his particular cultural and learning needs.

**Beatriz** is a Mexican American ELL student who is academically at grade-level. She usually has extensive writing output, but she demands clear language in order to understand learning and performance tasks.

**Tomasa** is also a Mexican American ELL student who is academically below grade-level. She has difficulty with writing output and with working efficiently. I chose Beatriz and Tomasa for this small group analysis of learning, so that I get an adequate sample of learning for our four ELLs and for one student who has recently exited the ELL program.

**Victor** is a slightly below grade-level White student from a low socio-economic background. He comes from a very fragmented family with many siblings. Victor tends to have trouble paying attention and exhibits low self-esteem at school. I included him in this sample group, so that I can thoroughly evaluate the impact my instruction had on his learning, his involvement in the classroom and his feeling of personal agency.

**Mandy** is an academically above grade-level White student who regularly exhibits the need for learning challenges outside of the general classroom curriculum. It has been my goal in this unit to provide Mandy with extended learning opportunities to meet her learning needs. She has been chosen for this sample in order to evaluate the learning strides that higher-level students were able to make.

### II. Learning Goals to be Analyzed

**Learning Goal 2 (LG2)**: The student will predict, collect, observe, organize, describe and record in a science journal physical data about rocks, minerals and experimental events.

**Learning Goal 3 (LG3)**: The student will use geological tools of inquiry to carefully observe, separate and isolate earth materials following established procedures.

## III. Assessment Data by Learning Goal

### *Learning Goal 2*

For Learning Goal 2, I collected basic pre-assessment data about the quality of students' predictions, based on their reasonableness and connections to prior learning (see Appendix I as well as the breakdown of student-by-student performance in making predictions in the LG2 section of the Design for Instruction chart, page 17). As a pre-assessment, I also collected information on the types of rock properties students were aware of. To set the stage and set them up to show all the knowledge they had about rock properties, I provided two examples of rocks to spur their thinking about ways they can observe the rocks (eg. color, shape, mass, etc.). My evaluation of their knowledge of rock properties also contributed to each student's evaluation in the LG2 section of the Design for Instruction pre-assessment chart.

For the formative assessment of Learning Goal 2, I evaluated students' understanding of rock properties through a mid-unit writing prompt asking the same question as the pre-assessment: "List the kinds of properties that can be observed in rocks," (see Appendix O). I also continuously evaluated students' predictions in their science journals via the same rubric that I used in the pre-assessment to evaluate reasonableness and connections to prior learning (see Appendix P). As an additional formative assessment, I evaluated their journals overall for the quality of observation skills they used, their communication skills, their understanding, and the number of minerals each student identified by the end of the unit (see Appendix Q for examples of journal entries and the journal entry rubric for each student).

As the post-assessment for Leaning Goal 2, I evaluated students on their ability to describe rocks by focusing on rock properties in a realistic context. Students had a mystery earth material that they had to describe as thoroughly as possible in a set amount of time (see Appendix R for examples). Then, each student received another student's descriptive writing and had to identify which mystery earth material was being described.

***Learning Goal 3***

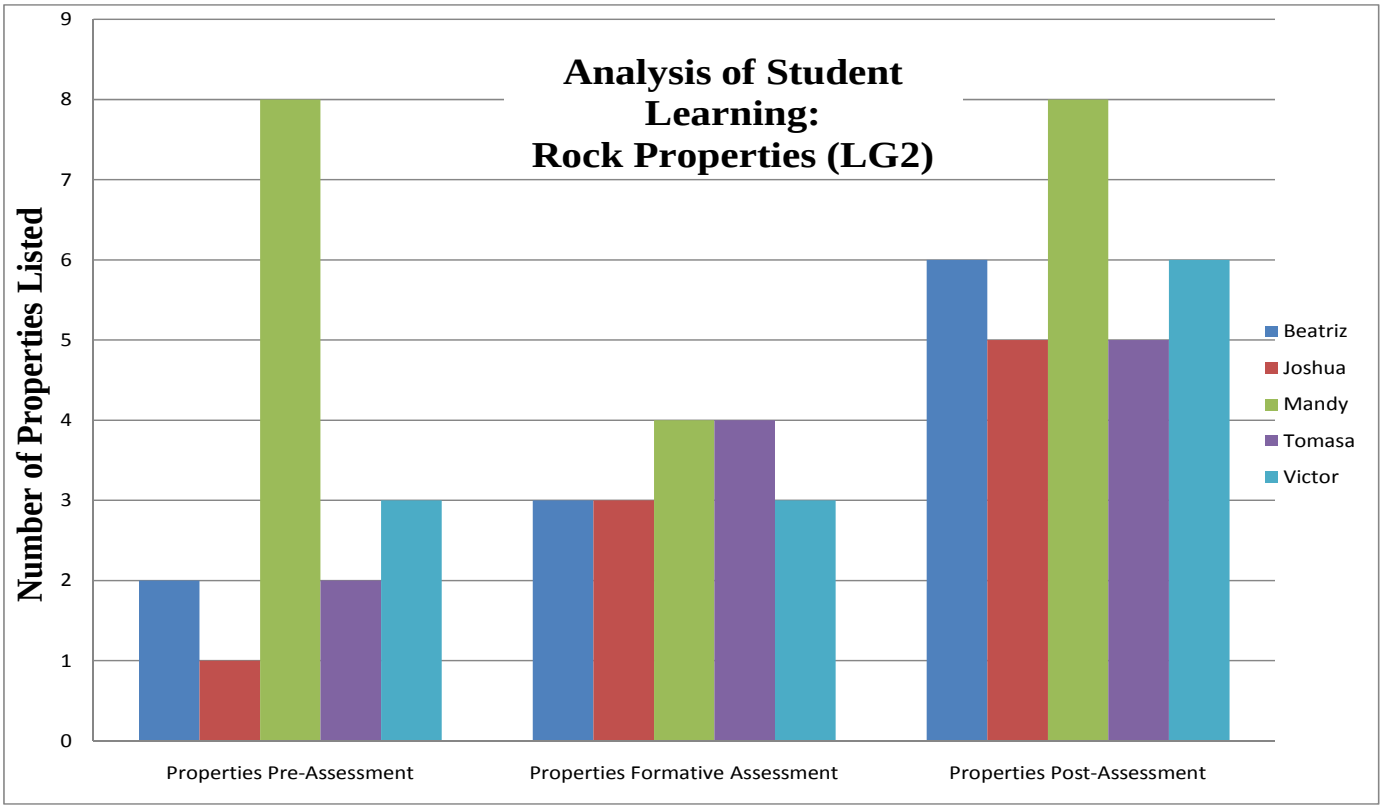
For the pre-assessment of Learning Goal 3, I collected very basic information about the ways students use a scientific inquiry tool, namely the magnifying lens, when given a task to complete. You will find the results from this simple pre-assessment on the LG3 portion of the Design for Instruction chart (page 17). You can also find the anecdotal notes form that I used to pre-assess students' use of the magnifying lens in Appendix S.

For the formative assessment of Learning Goal 3, I wrote anecdotal notes about students' performance during science experiments, focusing on their use of the inquiry tools and their reasoning for why they were using the particular tools and procedures to know more about rocks and minerals (see Appendix T). As a formative assessment, I also held small group performance sessions in which students had to work together to go over the complete scientific process for separating out the minerals from a mock rock. Through my constant and diversified questioning that I intentionally built into these small group performances, I was able to get an idea of each student's current status of understanding being the unit (see attached DVD to view the small group session of two of the three groups).

For the post-assessment of Learning Goal 3, I evaluated each individual student's understanding of the whole unit by doing a one-on-one interview that mirrored the small group interview that was done for the LG3 formative assessment. Students had to perform the whole sequence of experiments, explaining each step and how it connects to rocks and minerals, and responding to my prodding questions. See Appendix U for a break-down of each student's performance on the individual interview.

## IV. Evidence – Graphic Representations

**CHART 1**




***(See Appendix V for a larger version)***

- All students improved at each assessment, except for Mandy.
- All students had a cumulative score increase of 3 or 4 from pre- to post-assessment, except for Mandy.

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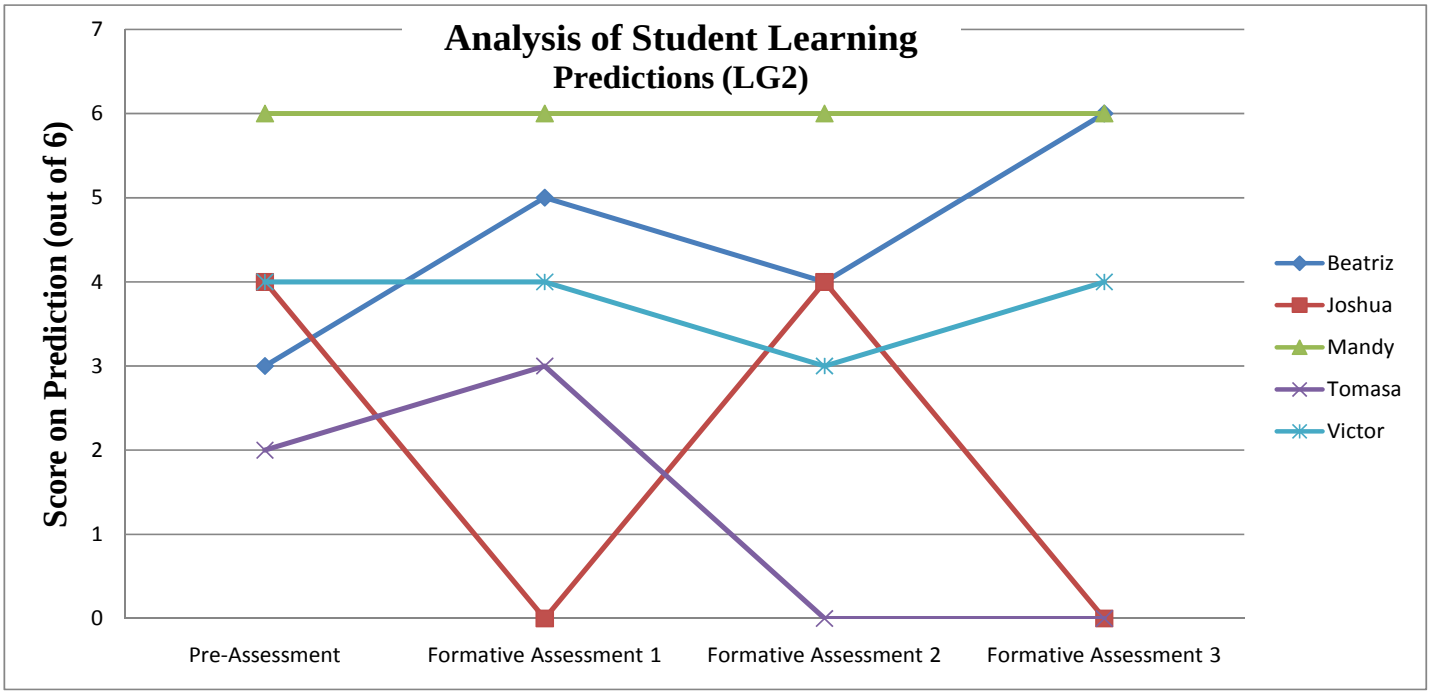
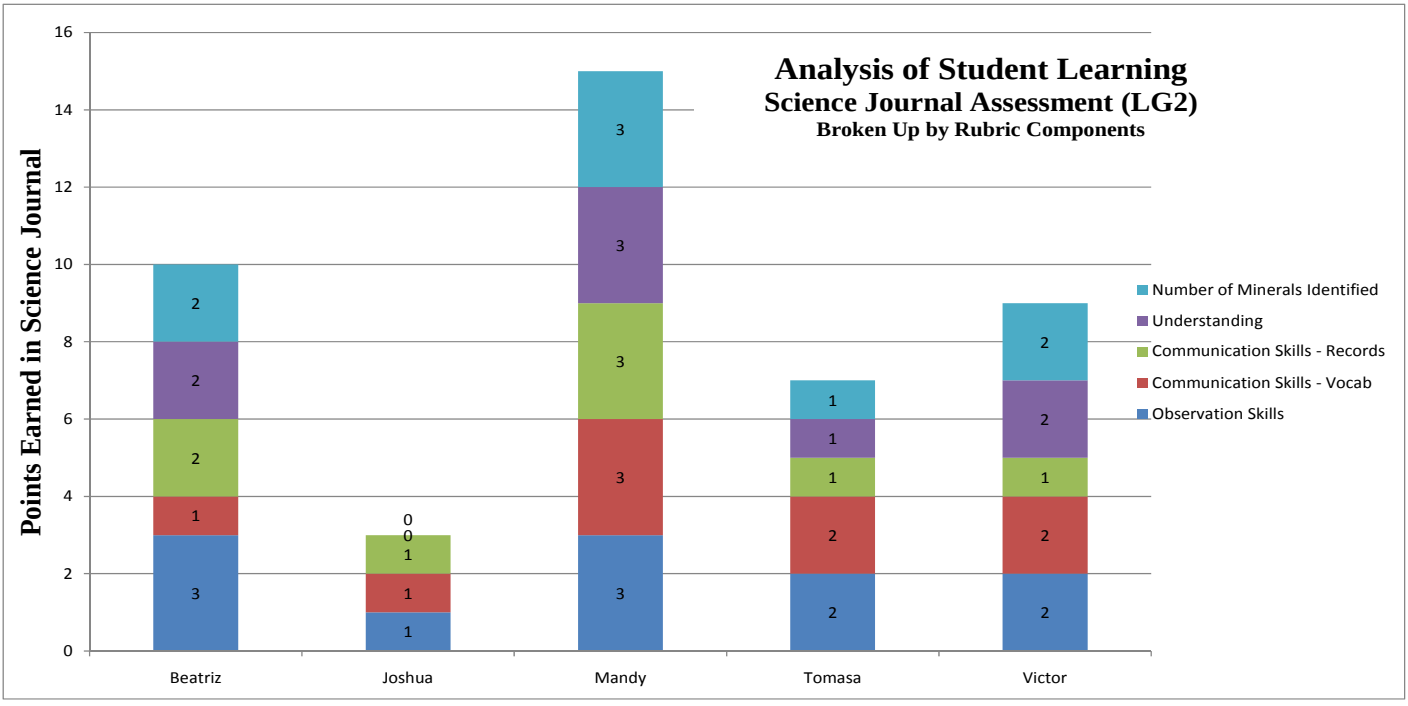
**CHART 2**




***(See Appendix W for a larger version)***

- Only one student (Beatriz) improved in her predictions.
- Two students' scores dropped overall, and two students' scores remained the same in the end.

## CHART 3




***(See Appendix X for a larger version)***

- Scores across the rubric were very consistent in each student's journal.
- Excluding Joshua from the data, the group earned the lowest score in journal recording communication.

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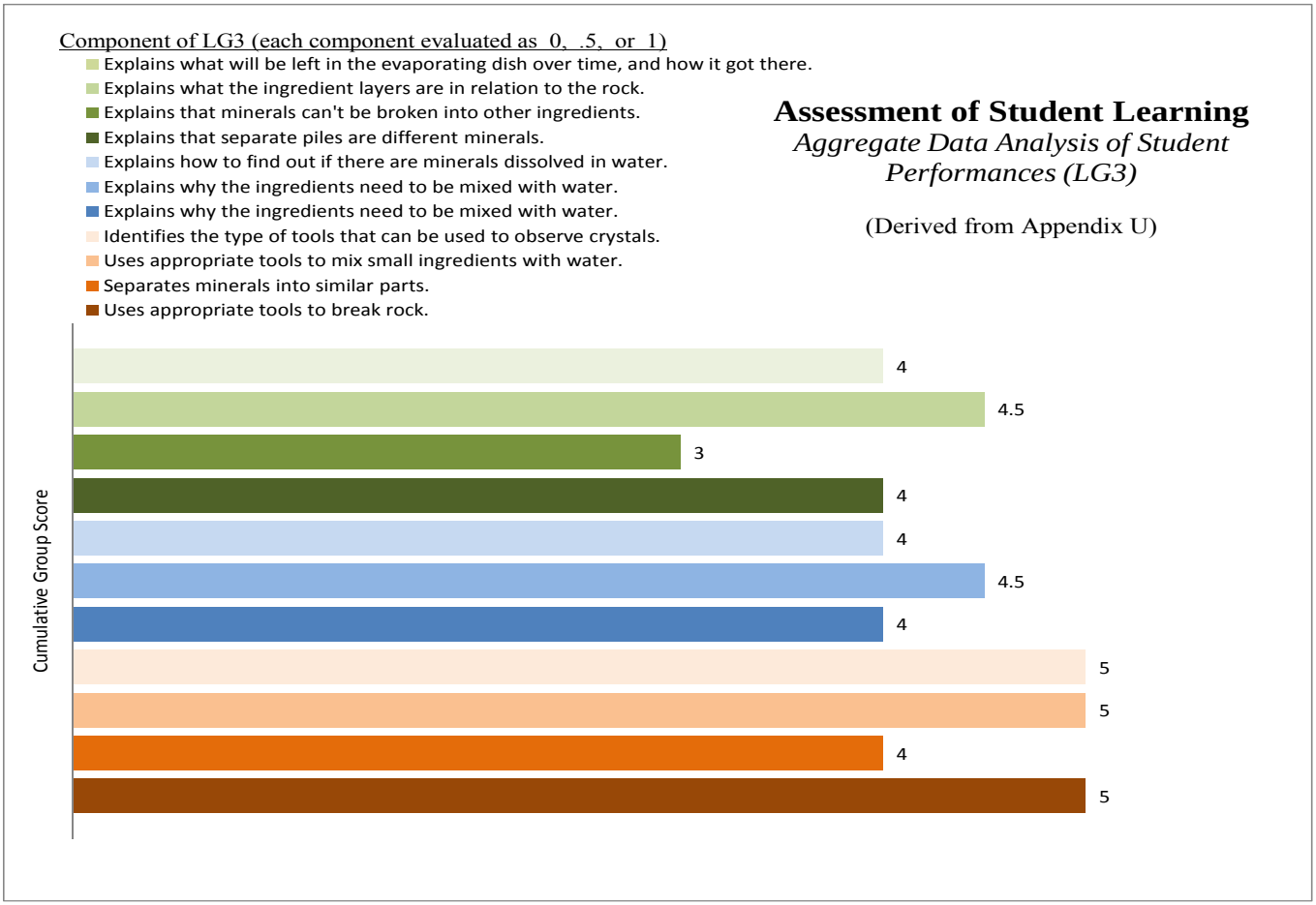
## CHART 4




***(See Appendix Y for a larger version)***

- The LG3 target category with the lowest aggregate score is GREEN, Procedural Reasoning (see Appendix U).

**CHART 5**

# Analysis of Student Learning

**Small Group Formative Assessment compared with Individual Post-Assessment**

(Derived from Appendix U)

*Lighter Color = Individual Performance in Small Group Formative Assessment*
*Darker Color = Individual Post-Assessment Performance*
*Scores based on a 0 – .5 – 1 scale, 1 being proficient*

LG3 Targets: Procedural Knowledge ►Procedural Explanation ►Procedural Reasoning

| | **Uses** appropriate tools to break rock. | **Separates** materials into similar parts. | **Uses** appropriate tools to mix small ingredients with water. | **Identifies** the types of tools that can be used to observe crystals. | **Explains** why the ingredients need to be mixed with water. | **Explains** what will happen to ingredients in water over time. | **Explains** how to find out if there are minerals dissolved in water. | **Explains** that separate piles are different minerals. | **Explains** that minerals can't be broken into other ingredients. | **Explains** what the ingredient layers are in relation to the rock. | **Explains** what will be left in evaporating dish over time and how it got there. | **TOTAL** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Beatriz | 1 | 1 | 1 | 1 | n/a* | 1 | 1 | .5 | 0 | n/a | 1 | 7.5/9 |
| | 1 | 1 | 1 | 1 | .5 | 1 | 1 | 1 | .5 | 1 | 1 | 10/11 |
| Joshua | n/a | 1 | 1 | 1 | .5 | 1 | 0 | 0 | n/a | .5 | .5 | 5.5/9 |
| | 1 | 0 | 1 | 1 | .5 | .5 | 0 | 0 | .5 | .5 | .5 | 5.5/11 |

- In categories where students' points changed from the formative assessment to the post-assessment, all of the changes involved an increase in proficiency, except the point changes of Joshua (1 to 0, and 1 to .5).

**V. Narrative Summary**

Based on my data analysis in the above charts, I can make some conclusions about students' learning. From Chart 1, I learned that all students, except Mandy, grew in their understanding and command of rock properties. In fact, they were able to list three to four more properties in the post-assessment than they were able to in the pre-assessment. I believe they grew in their proficiency for two reasons: a) I had intentionally increased our discussions of rock properties toward the end of the unit, and b) the post-assessment was a realistic and engaging task, which usually results in better student performance. The reason I suspect that Mandy didn't improve in terms of properties knowledge is that, in her pre-assessment, she listed eight out of the ten categories for rock properties – already demonstrating proficiency. Her formative assessment didn't earn a high score (only a 4), because I think it was simply out of context (a paper and pencil test, rather than an experiential performance like the post-assessment). Her post-assessment of properties received the same high score of 8, as in the pre-assessment.

Another conclusion I am able to make from this group analysis is that I was able to evaluate students' learning more thoroughly in the individual performance post-assessments than in their science journals. The interview was personal, sustained, open-ended and *spoken*. For the students in the class that struggle in writing, the added challenge of expressing scientific ideas in a journal often impedes the type of higher-level thinking and output they're able to produce in oral communication. For example, in reviewing Tomasa's science journal, I was unable to draw out clear conclusions about her learning,

because her struggle with writing output in combination with her ELL status made for very inconsistent journal entries. This was also the case with the journal work of Victor, who often struggles with staying attentive during writing tasks and large group tasks. This overall challenge of communicating ideas in the science journal is evident in the analysis of student journaling work (see Chart 3 above); the group's communication skills for recording observations (the green color) earned the lowest overall score on the science journal rubric. (This is not to discount the use of journals at all. These students continue to work at and incrementally improve their journaling abilities, which will prepare them for writing in the Science WASL and for writing in real life.)

On the other hand, during the one-on-one spoken interviews with both Tomasa and Victor, these two students led me through the process for separating out mock rock minerals and responded knowledgeably to my prodding questions. Both surpassed the standard for proficiency in LG3 (see Chart 5 above and top of page 11 of the Assessment Plan section). It was clearly a better assessment of their synthesis of knowledge than was the science journal. This conclusion can be generalized to the rest of the class, as well. To compare the five students' writing output in their science journals, see the examples in Appendix Q.

Another noticeable impact on student learning was the small group demonstration formative assessment. As you can see in Chart 5, the time spent in small groups to review the procedures and reasoning behind the mock rock mineral experiments resulted in improved student performances when they had to explain it all in their own words and actions during an interview with me. Other than Joshua, all of the students in this group made improvements from either a *0 to a .5* or a *.5 to a 1* in one or two categories. The category showing the most improvement (in fact, 5/6 of *all* the improvements) was the green category in Chart 5 – the most intellectually challenging category, Procedural Reasoning. Although the group's lowest category for performance ended up being Procedural Reasoning (as seen in Chart 4), the incremental group improvements from the formative assessment to the post-assessment are noteworthy and promising.

In terms of my analysis of the students' journal predictions (see Chart 2 above), I learned that such an analysis is rather misleading. Each prediction is based on a completely different topic and

completely different challenge level, so to compare them side-by-side doesn't lead to any conclusive trends in student learning. I believe it's because of this reason that students' prediction assessments appear so drastically inconsistent in Chart 2 (well, this plus the fact that two of the students simply didn't make predictions twice each). Since the making of predictions was not a learning goal in itself and is, rather, an ongoing process of exploration for these young scientists, I decided to add the students' predictions into the communication and understanding dimensions of their science journal rubrics to get a more balanced view of their journaling skills – communicating, understanding, predicting, observing, etc.

In analyzing my data for both Mandy and Joshua, it appeared that neither made much growth in their learning (Joshua staying low, and Mandy staying high). For Joshua, it was primarily due to regular absences and an overall inattentiveness during learning activities. He did appear to learn more rock properties, as evidenced in Chart 1 above, and he was engaged and contributory during nine out of the eleven discussion elements of the small group performance (see Chart 5 above and dark-haired boy in DVD Appendix Z). Mandy met all the learning goals early on in the unit, so her scores show nearly no growth in learning, based on the standards for proficiency for the whole class. I did, however, provide her with various extended learning activities. She researched on the Internet information about the geode rock she brought in for the class earth materials collection, and she presented her learning to the rest of the class. She was the leader of a very challenging small group mineral property task when the geologist visited the class. I also adapted my questioning for her during science experiments to tap into her higher-level understandings and generalizations about rocks and minerals. In addition, her journaling work is evidence of ongoing growth in learning, since she thoroughly explored and expressed her new ideas about geology, her predictions, her conclusions and the things she wondered about.

## B. Individual Analysis

### I. Introduction

Focusing on Learning Goal 2 and Learning Goal 3, I performed a more thorough analysis of Victor's work to gain better insight into his learning and to draw conclusions about the extent to which he met those two learning goals. I chose to analyze Victor's learning more closely, due to his low socio-

economic status and his characteristically low performance, low attentiveness and low sense of personal agency. I also chose Victor, because I am interested in the ways my seven young, male third graders experience learning in our classroom. The boys are the gender minority in the class, and they appear to learn and respond very differently than their female counterparts.

**II. Additional Assessment Data and Analysis**

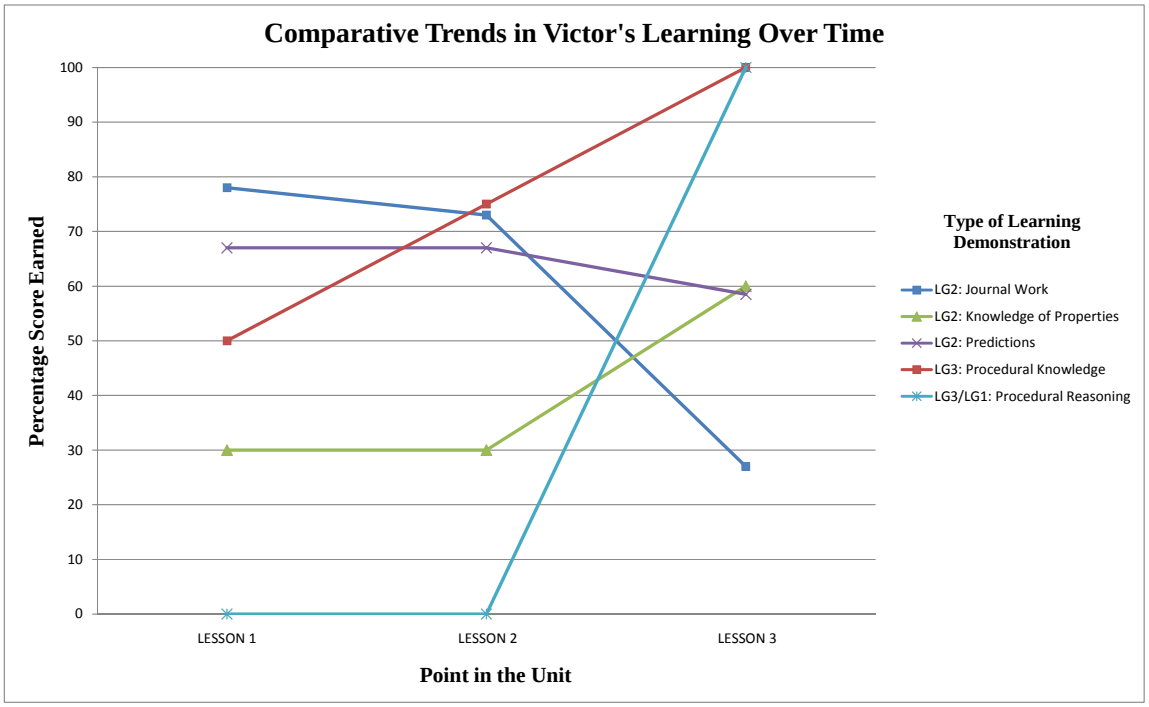
In the group analysis, I found that Victor met proficiency in his journal work, because he earned at least a 2 on three out of the five journal rubric components (see Chart 3 above). I decided to analyze each component more realistically by evaluating it at each lesson endpoint, rather than cumulatively over the whole unit. My reasoning behind this decision was that each particular journaling lesson focused on a certain type of learning (Lesson 1: rock properties; Lesson 2: visible rock minerals; Lesson 3: observing crystals). Therefore, the types of predictions, observations and expectations for communicating learning in the journal were vastly different from one lesson to the next. By analyzing Victor's journal work lesson by lesson, I was able to draw out his particular learning successes and challenges.

To gather informative data about his overall learning, I separated all the assessment data from Learning Goals 2 and 3 into three parts, aligning with the three lessons taught. I did this, so that I could track the incremental growth that Victor made throughout the whole unit and so that I could more confidently identify the factors that led to his success or his breakdown in learning. Since the point scales were different for the assessments, the graph is based upon the percentage scores Victor earned in each assessment (see Chart 6 below).

From my group analysis, I learned that Victor's ability to identify rock properties doubled (from 3 properties to 6) over the course of the unit. I decided to analyze the types of properties he became more aware of (see Chart 8 below), in order to qualitatively evaluate his improvement, rather than just quantitatively evaluate it. In my narrative, I also

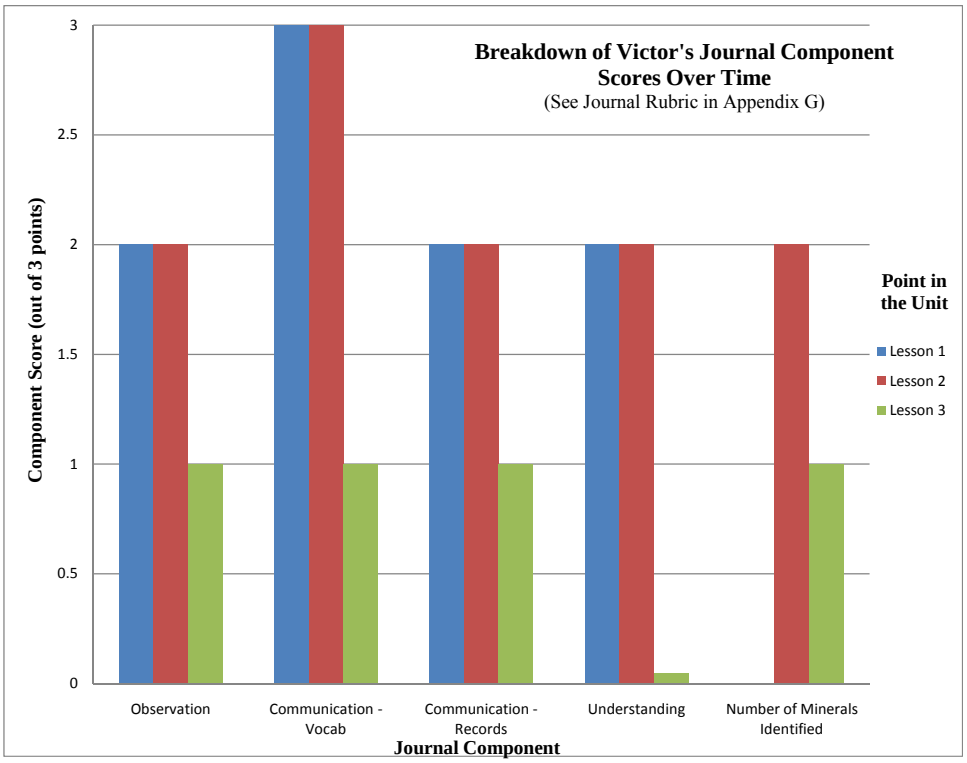
**III. Evidence**

**CHART 6**




***(See Appendix AA for a larger version)***

## CHART 7




***(See Appendix BB for a larger version)***

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## CHART 8

*Analysis of Properties Listed – LG2*

| Assessment Type | Number of Properties | Type of Properties Listed | Senses Used *(may be inferred)* |
|---|---|---|---|

| | Listed | | |
|---|---|---|---|
| Pre-Assessment | 3 | size, texture, weight | sight, feel |
| Formative Assessment | 3 | size, texture, weight | sight, feel |
| Post-Assessment | 6 | shape, texture, looks like, smell, color, sound *(didn't list size and weight this time)* | sight, feel, smell, hearing |

***(See Appendix CC for examples of Victor's properties assessments)***

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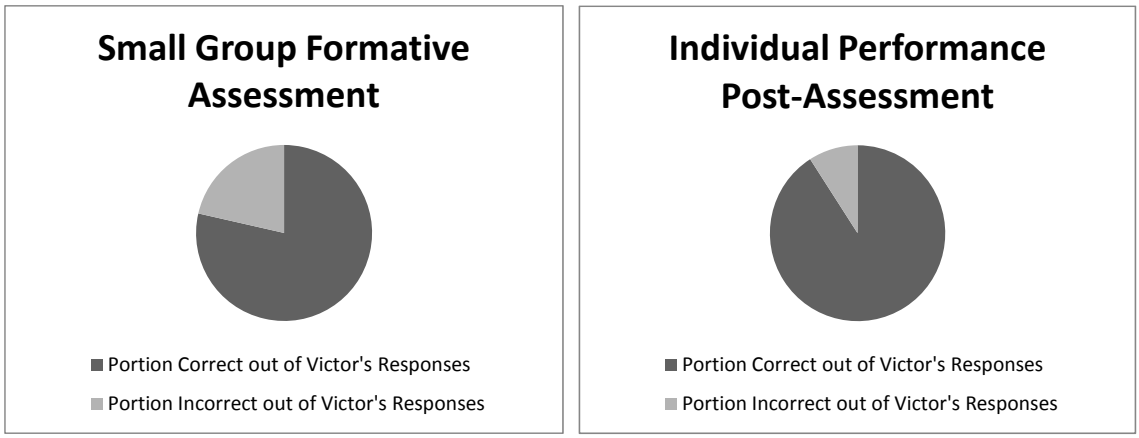
**CHART 9**

*Analysis of Student Performance – LG3*




**IV. Narrative Summary**

By breaking down Victor's journal entries into their rubric components and lessons, I was able to follow a trend of lowering performance (see Chart 7 above). I wanted to see why his journaling performance in the third lesson was so drastically lower than his journaling in the first two lessons. To do this, I analyzed three factors: a) the cognitive level of the content in each lesson, b) the degree of student-directed learning in each lesson, and c) the performance expectations put forth in the journal sections for each lesson. The content in Lessons 1 and 2 involved direct, concrete observations and manipulations of rocks. Victor was relatively free to observe and act on the rocks in the order he wished – a degree of autonomy that most likely caused a high degree of engagement in the Lessons 1 and 2 activities. The journal portions for Lessons 1 and 2 were almost completely prediction- and observation-based. They didn't require Victor to *explain* his conclusions based on the observations he made. His high level of engagement and output in the journal is probably a product of these three factors (concrete, accessible tasks; autonomy in the activity; and a low level of cognitive challenge in the journal prompts).

On the other hand, the content in Lesson 3 was about dissolving, evaporating and the crystallization of previously invisible minerals. All of these concepts are quite abstract. For this reason, many students, including Victor, had pervasive difficulties in grasping each concept and synthesizing the concepts into a generalization about rocks and minerals. This may have contributed to the low output and apparent lack of engagement in the Lesson 3 journal portion. In addition, the learning activity in Lesson 3 included teacher-scripted steps, so it was a little less hands-on and engaging than the previous two lessons – although it did involve the use of new tools, such as the microscope and mineral identification key. The journaling performance expectations for Lesson 3 required Victor to synthesize his learning over the whole unit to conclude how the crystals got in the evaporation dish and to conclude the total number of minerals found during the course of the unit – tasks that involved deeper analysis of learning than in the previous journaling tasks. These reasons give a clear context for why Victor may have performed so low on the final journaling portion of the unit.

In analyzing the types of properties that Victor used in his properties assessments, I noticed that he used four out of his five senses to make his list in the post-assessment, versus only two out of five senses in the pre- and formative assessments (see Chart 8 above). Although he left out *size* and *weight* in the post-assessment, he brought in new properties, *shape*, *color* and *looks like*, which demonstrates that he is still using his visual observation skills, and he brought in *smell* and *sound* observation skills, too. This proves that Victor has gained a deeper understanding about what a property is and about the different ways to use his five senses to observe rock properties.

The final analysis I did of Victor's learning was to evaluate the contributing factors to his remarkable success in the individual performance post-assessment of Learning Goal 3 (see Chart 5 above, page 37). In particular, I wanted to look more closely at the qualities of my instruction that contributed to his attainment of proficiency in this learning goal. Such an analysis will reveal the types of instruction and support that I should continue to provide for students like him. To reiterate, LG3 states that *the student will use geological tools of inquiry to carefully observe, and knowledgeably separate and isolate earth materials following established procedures*. The key word in this learning goal is *knowledgeably*; it isn't enough that the student be able to follow the procedures correctly but not

understand what he is doing and why. For this reason, success in most of the Procedural Explanation and Procedural Reasoning components of LG3 are required for attaining that goal (see Chart 5 again).

The first quality of my instruction that probably played a role in Victor's attainment of LG3 was the design of experiential learning for every lesson (some lessons to a higher degree of experience than others). Because of these meaningful and engaging learning experiences, he was able to learn by doing, which most often leads to deeper, better retained learning. Another quality of my instruction that probably positively contributed to Victor's success at LG3 is the repeated discussion, rehearsal and explanation of the experimental procedures at regular intervals throughout the unit. Such revisiting of content also leads to deeper, better retained learning and more confident expression of learning. Substantiated confidence-building must be an essential element of Victor's academic instruction, since he often lacks a sense of agency in his world (in part, due to his low socio-economic status and his fragmented family life – see Victor's description, page 32).

## REFLECTION

**Most Successful Learning Goal**

The most successful learning goal in this unit was probably Learning Goal 2: *The student will predict, collect, observe, organize, describe and record physical data about rocks, minerals and experimental events*, because it was the goal that I most regularly assessed and because it had the most structured opportunities for student demonstration of learning. For example, students made extensive observations and organized and recorded physical data in their science journals everyday. They also had the opportunity to record their observations of earth materials in the written LG2 properties post-assessment. In general, this class of students is able to produce a lot of writing during literacy. Their written science products were no exception. Another factor that probably assisted in their success at recording observations and conclusions in their journals was the fact that, just prior to this unit, the students had practice using the same journal format for the FOSS Measurement unit. This familiarity of writing materials set them up to experience a predictable lesson structure and a predictable set of performance expectations, resulting in more success by more students.

**Least Successful Learning Goal**

The least successful learning goal in this unit was Learning Goal 4: *The student will use written communication to demonstrate real life connections to rocks, minerals and geology*. The reason for this judgment is that LG4 was not fully completed, due to time constraints brought about by the Nooksack Valley School District's pacing guide for 3rd grade science. Students were only able to write their first letter to Aunt Rita or Teresa, their questions for the visiting geologist and simplified thank you letters to the visiting geologist (see Appendix DD for examples of these written products). Also due to the time constraints, the writing self-evaluation student checklist (see Appendix L) was only used superficially as a guide for writing their thank you letters at the end of the unit, rather than a unit-long educational instrument, as I had initially intended. Because of the resultant scattered nature of the LG4 writing activities, the students' realistic writing about geology morphed into isolated extended learning tasks, instead of a previously described learning target I had hoped to thread throughout the whole unit. In future science units, I hope to achieve this goal of writing for a real audience by devoting a sustained amount of time to science on the days I do teach that subject. In this manner, the students will be guaranteed the opportunity to explore concepts through experiential learning, discuss their thinking, draw conclusions and share their learning and interests by writing to various real-life audiences.

**Reflection on Possibilities for Professional Development**

One specific learning goal I have for my professional development as an elementary teacher is to increase my knowledge of what a quality science journal is. In the Earth Materials journal I created, every lesson begins with a guiding question about which the students must make a prediction, prompts students to document their observations in writing and drawing, and prompts students to make a conclusion about their learning and a reflection about their current questions or interests. However, I would like to learn more about how to best set up those journal components. I would also like to learn about the other journal components to include that most appropriately challenge students to comprehend and synthesize their learning. Two steps that I plan to take to increase my knowledge about quality science journals are a) to attend district staff trainings about science instruction (for example, through the local Educational Service District 189) and b) to work alongside a mentor teacher in the district (for

example, one of the few teachers who have a Masters Degree in Science Education) to develop the next science unit's journal together.

The other learning goal I have for my professional development is to build up my knowledge of the content behind the science unit (or any subject, for that matter) that I teach. The reason I have this goal is that throughout this Earth Materials unit, I regularly encountered uncertainty in how to deal with students' misconceptions and students' needs for alternative demonstrations of concepts. If I have a firm base of knowledge about the topic I teach, I will be able to better expect the types of misconceptions that may arise, and I will be able to think better on my feet to present information in multiple ways to the diverse learners of my classroom. To truly meet this professional development goal, I will regularly access the following resources to perform curriculum topic studies on the science subjects I teach, before I teach them: Science for All Americans, Science Matters, The Atlas of Science Learning, Science Curriculum Topic Study, Making Sense of Secondary Science, Benchmarks for Science Literacy and the National Science Education Standards. In combination, these resources will equip me with the fundamental knowledge and big ideas that students must learn and the knowledge of how to teach the content, so that I can prioritize what I teach and strategize how to teach it most successfully to all students. Another step I can take to meet this professional development goal is to intentionally seek out and surround myself with local community resources that could provide additional science learning opportunities for me and for my students. For example, the Nooksack Salmon Enhancement Group could teach me valuable understandings about salmon and the environment that I could then bring to my unit instruction on the life cycle of salmon. Or they could even partner with me to jointly teach the unit, integrating both of our strengths for the learning benefit of the students.

## APPENDIX CONTENTS

**Appendix A**

*LG1 Pre- and Post-Assessments ~ Comprehension Checklist*

Name: _____

| **Knowledge Component** | **Achieved?** |
|---|---|
| The student explains that rocks are made up of minerals. | |
| The student explains that minerals cannot be physically separated into other ingredients. | |
| The student explains that rocks and minerals are non-living earth materials. | |

**Appendix B**

*LG1 Post-Assessment ~ Student Self-Evaluation Rubric*

Name: _____

| Think about… | **1** | **2** | **3** |
|---|---|---|---|
| **…what I already know about rocks and minerals.** | I have not learned anything new about rocks and minerals. | I know a little bit more about rocks and minerals now. | I know a lot more about rocks and minerals now. |

| | | | |
|---|---|---|---|
| **…what I would like to know about rocks and minerals.** | I didn't learn the answers to the things I wanted to know about rocks and minerals. | I learned some of the answers to the things I wanted to know about rocks and minerals. | I learned all of the answers to the things I wanted to know about rocks and minerals. |
| **…my confidence about rocks and minerals.** | I wouldn't want to share what I know about rocks and minerals with a geologist. | I would kind of like to share what I know about rocks and minerals with a geologist. | I would really like to share everything I know about rocks and minerals with a geologist. |
| **…my interest in rocks and minerals.** | I don't want to learn anything more about rocks and minerals. I would like to learn about something else. | I want to learn a little bit more about rocks and minerals, and then learn about something else. | I want to keep on learning, experimenting and researching about rocks and minerals. |

**Appendix C**

*LG1 Formative Assessment ~ Conferencing and Anecdotal Notes Form*

Names: _____

| |
|---|
| Question: Can you identify the ingredients that make up your mock rock? |
| Question: If you had another mock rock made of other ingredients, would it be the same as your mock rock? Why/why not? |
| Question: Imagine you put all the ingredients back together. How would this new rock be the same? How would it be different? |
| Question: What about rocks are you learning right now? |
| Question: From doing this experiment, are you able to answer for me what the difference is between rocks and minerals? |
| Other notes: |

## Appendix D

*LG1 Formative Assessment ~ Cookie Homework Rubric*

Name: _____

| Question | 0 | 1 | 2 | 3 |
|---|---|---|---|---|
| *A student wrote in her journal, "A rock is like a chocolate chip cookie." What do you think she meant when she wrote that sentence?* | The student does not turn in the homework or demonstrates a clear lack of effort to find a connection between the cookie and the rock. | The student discusses shape, color, smell, texture, hardness and/or weight similarities between the cookie and the rock, but does not include any mention of ingredients or minerals. | The student explains that cookies and rocks are made of different things, but does not use science vocabulary (such as "minerals") to make this explanation clear. | The student explains that rocks are composed of minerals and clearly connects this fact to the idea that a cookie is composed of different ingredients mixed together. |

## Appendix E

*LG1 Post-Assessment ~ Written Assessment*

Name: _____

| Question | 0 | 1 | 2 | 3 | Score |
|---|---|---|---|---|---|
| **What is the difference between a rock and a mineral?** | The student does not explain a difference between a rock and a mineral. | The student explains that the difference is a degree of size, weight, color, shape, hardness, texture, luster or some other property. | The student explains that rocks are made of minerals, but the student leaves out what the difference is between a rock and a mineral. | The student explains that rocks are made of minerals, that rocks can be separated into their mineral ingredients, and that minerals cannot be separated into other ingredients. | |
| **How did mixing the rocks in water help you learn more about rocks and minerals?** | The student does not explain why mixing the rocks in water helped them learn more about rocks. | The student explains that the process caused a simple, visible change inside the vial. For example, it made the water look dirty or turn colors. | The student mentions different "parts" of the mock rocks. For example, the student explains that the process showed them different layers in the vials that were sand, dirt and bubbles. | The student explains that the process separated out the different ingredients/ parts/minerals of the mock rocks into new ingredients we hadn't seen before. | |
| **Probing for elaboration.** | The student does not respond orally following a verbal prompt. | The student repeats his/her response following a verbal prompt. | The student paraphrases his/her response following a verbal prompt. | The student elaborates in a different or more complex way his/her response following a verbal prompt. | |

| | |
|---|---|
| | **Total Score: / 9** |

**Appendix F**

*LG2 Pre- and Post-Assessments ~ Property Checklist and Tally Sheet*

Name: _____

| Property | Is it present? |
|---|---|
| color | |
| texture | |
| weight | |
| length/size | |
| shape | |
| what's in it | |
| smell | |
| hardness | |
| luster | |
| what it looks like | |
| (other) | |

**Appendix G**

*LG2 Formative Assessment ~ Journal Observations Rubric*

Name: _____

| Dimension of Performance | 0 | 1 | 2 | 3 | Score |
|---|---|---|---|---|---|
| **Observation Skills** | Fails to use sensory details to describe observations. | Uses few sensory details to describe observations. | Uses several sensory details to describe observations. | Uses extensive, exact sensory details to describe observations. | |
| **Communication Skills** | No use of new science vocabulary. | Slight use of new science vocabulary. | Uses new science vocabulary to describe observations and results. | Extensive use of new vocabulary to describe observations and results. | |
| | Recordings not easily understandable; drawings are not neat, labeled and detailed. | Sometimes records observations in an understandable way; sometimes includes neat, labeled drawings. | Records observations in an organized way; neat, detailed drawings are labeled. | Consistently records observations in an organized way: accurate, labeled, dated drawings. | |
| **Understanding** | No evidence of understanding the relationship between rocks and minerals. | Minimal evidence of understanding the relationship between rocks and minerals (may only be inferred). | Clear evidence of understanding the relationship between rocks and minerals (at least one example). | Extensive evidence of understanding the relationship between rocks and minerals (more than one example). | |
| **Number of** | Two or fewer "minerals" found in the mock rock. | Three to four "minerals" found in the mock rock. | Five to six "minerals" found in the mock rock. | Seven or more "minerals" found in the mock rock. | |

| | | | | | |
|---|---|---|---|---|---|
| **"Minerals" Identified** | | | | | |
| | | | | | **Total Score: / 15** |

**Appendix H**

*LG2 Formative Assessment, LG3 Pre- and Formative Assessments ~ Anecdotal Notes Form (shrunken version)*

| | | | |
|---|---|---|---|
| Student Name | Student Name | Student Name | Student Name |
| | | | |
| Student Name | Student Name | Student Name | Student Name |
| | | | |
| Student Name | Student Name | Student Name | Student Name |
| | | | |
| Student Name | Student Name | Student Name | Student Name |
| | | | |
| Student Name | Student Name | Student Name | Student Name |
| | | | |

**Appendix I**

*LG2 Formative Assessment ~ Process Predictions Rubric*

Name: _____

| Dimension of Performance | 0 | 1 | 2 | 3 | Score |
|---|---|---|---|---|---|
| **Reasonableness** | The student makes no prediction or predicts something unrelated to the situation. | The prediction is unlikely and/or left to inference. | The prediction is likely, but is not clearly explained by the student. | The prediction is likely and is clearly explained by the student. | |
| **Connections to Prior Understandings** | The student makes no prediction or predicts something unrelated to the situation. | The prediction is not related to the lesson or to prior understandings the student has. | The prediction is connected to prior understandings learned in this or other contexts. | The prediction is explicitly and descriptively connected to prior understandings. | |
| | | | | | **Total Score: / 6** |

**Appendix J**

*LG3 Formative and Post- Assessment ~ Checklist and Anecdotal Notes Form*

Name: _____

| Performance | Achieved? (1, .5 or 0) |
|---|---|
| 1. The student **breaks** the rock into pieces using appropriate tools. | |
| 2. The student **separates** the pieces into similar parts using appropriate | |

| | |
|---|---|
| tools. | |
| 3. The student **explains** that the separate piles are different minerals. | |
| 4. The student **explains** that the minerals cannot be physically broken into other ingredients, but the rock can. | |
| 5. The student **shows** how to mix the small ingredients with water using appropriate tools. | |
| 6. The student **explains** why the ingredients need be mixed with water (a. separate ingredients into size; b. dissolve some ingredients). | |
| 7. The student **explains** what will happen to the ingredients in the water over time. | |
| 8. The student **explains** what those ingredient layers are in relation to the rock. | |
| 9. The student **explains** how to find out if there are minerals dissolved in the water using the appropriate tools. | |
| 10. The student **explains** what will be left in the evaporating dish over time, how it got there and what it is (a mineral from the rock). | |
| 11. The student **identifies** the types of tools that can be used to observe crystals. | |
| Notes… | **Total Points:** |

**Appendix K**

*LG4 Pre-, Formative and Post-Assessment ~ Letter Writing Rubric*

Name: _____

| Dimension of Performance | 0 | 1 | 2 | 3 | Score |
|---|---|---|---|---|---|
| **Inquiry** | The student does not ask questions about the person or the person's experiences with rocks and minerals. | The student asks few questions that are connected to the person's experiences with rocks, minerals and geology. | The student asks some thoughtful questions about the person. These questions are connected to rocks, minerals, geology and the readings. | The student asks many thoughtful questions about the person and her experiences. These questions are connected to rocks, minerals, geology and the readings. | |
| **Engagement** | The student writes very little and uses no expression or personal thinking on the subject of rocks and minerals. | The student writes about a topic that he/she is indifferent toward:<br>• uses little expression<br>• rarely shares personal thoughts or connections | The student writes about a topic that is somewhat interesting to him/her:<br>• uses some expression<br>• shares some personal thoughts and connections | The student writes about a topic that is interesting to him/her:<br>• uses enthusiastic expression<br>• shares many personal thoughts and connections | |
| **Sharing of Learning** | The student does not share what he/she has been learning about rocks, minerals and geology. | The student shares one significant thing he/she has learned about rocks, minerals and geology. | The student shares two significant things he/she has learned about rocks, minerals and geology. | The student shares at least three significant things he/she has learned about rocks, minerals and geology. | |

| | | | | | |
|---|---|---|---|---|---|
| **Attention to Detail** | The student writes few to no descriptive sentences and demonstrates a lack of awareness or interest in the target audience. | The student writes some descriptive sentences that demonstrate an awareness of the target audience. | The student writes many descriptive sentences that ensure that the target audience understands him/her. | The student writes clear, detailed sentences with supportive evidence where appropriate, and also demonstrates awareness of the target audience. | |
| **Conventions and Clarity** | The student's writing is unreadable, due to illegible penmanship and little or no attention to punctuation, capitalization and spelling. | The student hand-writes legibly only some of the time, and correct punctuation, capitalization and spelling is very inconsistent. | The student uses legible hand-writing and correct punctuation, capitalization and spelling some of the time. | The student uses legible hand-writing and pays close attention to punctuation, capitalization and spelling most or all of the time. | |
| | | | | | **Total Score: /15** |

**Appendix L**

*LG4 Formative and Post-Assessment ~ Writing Self-Assessment Checklist*

Writing Self-Assessment Checklist Name: _____

**Put a √ where you think you have done a good job in your writing about rocks and minerals.**

1. I ask lots of smart questions about what the person is learning and experiencing. _____

2. I write about the things I am interested in most about the person. _____

3. I share many important things about what we are learning and experiencing in science. _____

4. I use lots of details and description, so that the reader can imagine what I mean. _____

5. My writing is clear and easy to understand for the reader. _____

**Appendix M**

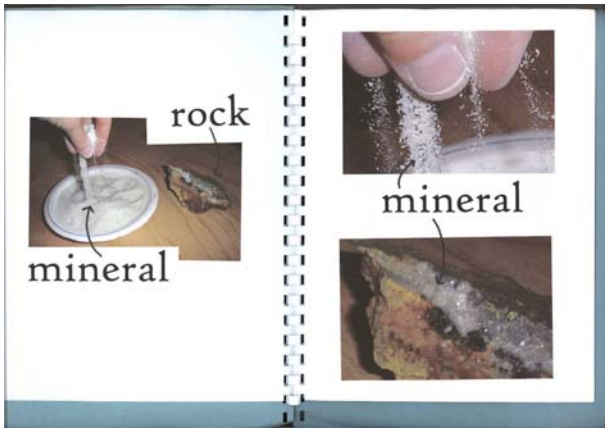
*LG4 Post Assessment ~ Thank You Letter Writing Rubric* (in addition to Appendix K)

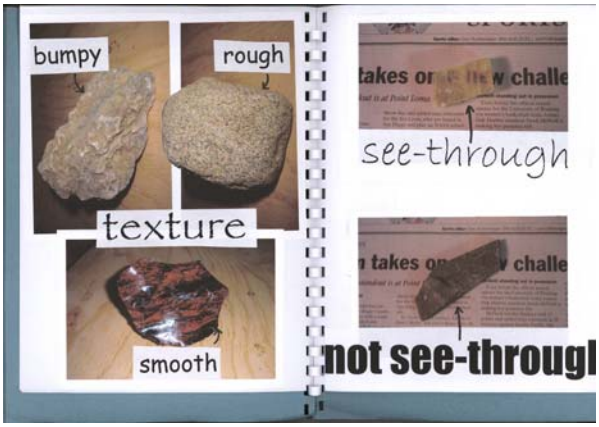
| Dimension of Performance | 0 | 1 | 2 | 3 | Score |
|---|---|---|---|---|---|
| **Expression of Gratitude** | The student does not include a "thank you" in his/her letter. | The student makes his/her gratitude clear by saying "thank you" to the geologist. | The student makes his/her gratitude clear by saying "thank you" and by briefly explaining why he/she is thankful to the geologist. | The student makes his/her gratitude clear by saying "thank you" and by clearly explaining why he/she is thankful to the geologist. | |

**Appendix N**

*Adaptation for ELL Student who Receives Special Education ~ Picture Dictionary*

EXAMPLE PAGES OF PICTURE DICTIONARY:



tools

safety goggles

tools

rock pick

nail

tools

magnifying lens

←microscope

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Mandy | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |

- Strong command of reasoning for why certain procedures were necessary in order to separate and isolate all minerals from the mock rock. Looks at the big picture.
- Challenged by having to explain the reasoning for each step of the process of isolating mock rock minerals, so this is something to stick with in the future to challenge her thinking.
- Prod her to pose alternative procedures and to evaluate their advantages and disadvantages.

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Tomasa | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | .5 | 1 | 1 |

- Hesitates between thinking that minerals can be physically broken into other ingredients and thinking that minerals cannot be physically broken into other ingredients. Ultimately stated that minerals cannot be separated into other ingredients.
- Understands that the layers in the vial are different minerals from the mock rock.

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Victor | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | .5 | 1 | .5 |

- Thinks that water is inside the crystals.
- Appears to rely heavily on the response of "minerals," but demonstrates understanding that they are in rocks and can be separated out of the rocks.
- Aptly summarized the whole process in two sentences at the end of the interview, demonstrating strong understanding and recall of the procedures.

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