Lesson Research Proposal for 2nd grade Earth's Surface Changes
For the lesson on November 8, 2016
Science Conference: "It's Go Time: Seeing the future through the NEW NYS Science Learning Standards"
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1. **Title of the Lesson:** Creative Solutions

2. **Brief Description of the lesson:** Students will be designing and testing a solution to slow or prevent erosion. Prior to this lesson, students have been investigated the effectiveness of various materials that model actual erosion prevention materials. In this lesson, they will only be allowed to select two materials for this design. Students will be asked to evaluate and compare the effectiveness of different design solutions and apply that to modifying their design.

3. **Research Theme:** Designing and Comparing Solutions
Students will engage in the engineering practice of designing solutions to slow the process of erosion. Students will generate and carry out a plan for quantifying how much sand is moved by water to facilitate the class in comparing the various design solutions.

Students will use notebooks to document reasoning and ideas related to their designs. Notebooks will also be used to support students in comparing design solutions and supporting students in engaging in evidence-based discussions to determine which design solutions worked best.

4**. Goals of the Unit:**
Students will be able to:

a. Show how models can represent real life examples and can be used to test various designs. Models will represent grass, sandbags, trees, and retaining walls.
b. Understand ways to slow the process of erosion.
c. Compare materials and the effect on slowing or preventing erosion.
d. Using a science notebook effectively to track their thinking, make observations, and plan design solutions.
e. Engage in the engineering design process
f. Collect evidence to support claims that wind and water can change the shape of land and that this can happen slowly or rapidly.
g. Collect evidence to support claims and argumentation to compare various design solutions.

5. **Goals of the lesson:** Students will engage in the engineering design process to develop, evaluate, compare, and redesign solutions to slow the process of erosion.

a) Students will understand that a model represents a real-life situation and can be used to test and compare design solutions.
b) Students will be able to demonstrate their knowledge of erosion and the prevention of it by developing a plan.
c) Students will be able to test their design in order to decide if it is effective.
d) Students will be able to make a claim statement that evaluates the effectiveness of their design solution.

6. **Relationship of the Unit to the Standards**:

Learning standards for this unit	**Related later learning standards**	
2-ESS2-1 Compare multiple solutions designed to slow or prevent wind or water from changing the shape of the land.	4-ESS2-1 Make observations and/or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind or vegetation.	5-ESS2-1 Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere and/or atmosphere interact.

7. **Background and Rationale:**

The NGSS link to the *Framework for K-12 Science Education*, which was released in 2011 and used as the research basis for the new standards. A summary of the development of the *Framework*, as well as a link to the document can be found here: http://www.nextgenscience.org/framework-k–12-science-education.

ESS2.A: Earth Materials and Systems: Wind and water can change the shape of the land. As articulated in the *Framework*, this disciplinary core idea focuses on the interactions of Earth's major systems. Students should understand the dynamic nature of the Earth's systems including focusing on interactions over various time scales to understand the Earth's surface changes, somes slowly and sometimes rapidly. Students begin in second grade by focusing on understanding that wind and water can change the shape of the Earth at different rates. By the end of 5th grade, students gain an understanding of Earth's main systems and their interactions, including humans' impact on Earth's systems. In middle school, the students begin to understand that energy flow is the reason for all of Earth' processes. By the end of high school, students understand complex feedback mechanisms, including plate tectonics.

Science and Engineering Practices: This unit and lesson focus on the practices of understanding and using models, planning and carrying out investigations, and designing

solutions. The descriptions of all eight science and engineering practices, along with the articulation of each practice's progression K-12 can be found in Appendix F of the NGSS. It is important for students to engage in the science and engineering practices for their own conceptual understanding of science phenomena as well as the discipline of science. Specifically, the Framework notes "that students cannot fully understand scientific and engineering ideas without engaging in the practices of inquiry and the discourses by which such ideas are developed and refined. At the same time, they cannot learn or show competence in practices except in the context of specific content" (NRC, 2012, p. 218). Students must engage in science and engineering practices to develop an understanding of scientific concepts. The two cannot be separated.

In this unit, students have been learning how models can represent real things. Specifically, they have investigated how sand is a model of soil. Additionally, students have been using various materials to represent real-life erosion prevention materials (ex. cotton balls to model sand bags). Students are understanding how these models can be used to test various design solutions. In K-2, students are beginning to understand models and engage in modeling as a practice. "Modeling can begin in the earliest grades, with students' models progressing from concrete 'pictures' and/or physical scale models (e.g. toy car) to more abstract representations of relevant relationships in later grades, such as a diagram representing forces on a particular object in a system" (NRC, 2012, 58).

Students have been planning, with support, to carry out investigations collaboratively to test various design solutions. Specifically, students have been planning and conducting investigations "to produce data to serve as the basis for evidence to answer" (NGSS Lead States, 2013, p. 55) the driving question for the unit: "How can we stop soil from washing away?". Additionally, students have been working on making observations and quantifying erosion to compare various design solutions. In all aspects, students have been working on engaging in the practice collaboratively.

Crosscutting Concepts: Stability and Change.

Crosscutting concepts unify the disciplines of science and "have value because they provide students with connections and intellectual tools that are related across the differing areas of disciplinary content and can enrich their application of practices and their understanding of core ideas" (NRC, 2012, p. 233). The seven crosscutting concepts and the associated K-12 progression can be found in Appendix G of the NGSS.

The aspect of stability and change associated with the unit and the K-2 grade level band is acknowledging that some events happen very quickly while others occur very slowly. This crosscutting concept will progress in grades 3-5 to include measurement to understand rate, as well as understanding that some change occurs over a time period much longer than one can observe.

ETS1.C: Because there is always more than one possible solution to a problem, it is useful to compare designs.

During our discussion about the lesson, we talked about how the students will remember how much erosion each group had during the class discussion. We know that they are second graders and that developmentally they are prone to not remember things unless there are visual representations or notes about each design. We decided to create a note taking sheet to help the groups quantify each group's erosion with the triangle, and we also added a noticing section for any other notes they may want to take on each design.

8. **Research and Kyouzai kenkyuu:**

In researching this topic of Processes that Shape the Earth, the team referred to the NGSS for 2nd grade, and found unit 2. Earth's Systems. The team also reviewed the the Framework, specifically the articulation of the progression for Earth's System. Additionally, reviewing the appendices in the NGSS related to the crosscutting concepts and science and engineering progressions was helpful in understanding the relative expectations for second grade. The team also looked at the NYS Common Core Standards. Both sets of standards included necessary skills for second grade students.

Within the ELA State Standards, students come to second grade knowing how to listen, to question, and answer appropriately. They are able to use text features. The students can recognize headings, key facts, and details. The students use prompting from their teacher to read informational text. Their reading foundation allows the students to demonstrate the understanding of spoken words. Last, in writing, students come with the ability to name a topic and supply some facts about the topic.

During math instruction, 1st graders are given strategies to problem solve and are asked to show their thinking on a daily basis.

Our team used this information to realize and understand what our second graders were capable of doing and what we could push them to do. We then thoroughly examined the NGSS for second grade and the place we were in the second grade curriculum. Standard 2 "Processes that Shape the Earth" had four parts. Our team decided to focus on 2-ESS2-1, for this lesson study lesson. Our students will be using multiple sources for information at the beginning of the unit to see how Earth's events can occur quickly and slowly. Our lesson will primarily focus on the students comparing multiple solutions to design a way to prevent, or at least slow down, the changing shape of the Earth, specifically erosion.

The teacher guide used to plan this lesson was "How Can We Stop Soil from Washing Away". This came from the Smithsonian Science Education Center. In this guide, the module is described as being part of new curriculum series being developed by SSEC, the goal is for the unit to be: research-based, fully aligned to national standards, student-centered, kit-based, and centered on a coherent storyline. This unit is specifically aligned to be in succession to the 1st grade NGSS performance expectation, with a focus on on engineering design. The guide we used is a draft for field testing. As a group we used our collective knowledge and expectations for our students to carry out this unit, but specifically this lesson in completion. Our hope is to

expand the knowledge base and persistence in our students, while fostering a personal desire to solve problems and use strategies to do so.

9. **Unit Plan (as articulated in the Smithsonian Science in the Classroom draft unit titled "How Can We Stop Soil from Washing Away?")**

Lesson	Learning Goals and tasks
1	Teachers collect students' initial ideas about erosion.
2	Students investigate sand and water together.
3	Students apply their learning from lesson 2 to a real-world situation.
4	Students compare models for environmental materials to the actual materials.
5	Students test the impact of model materials with water and sand.
6	Research Lesson: Creative Solutions Students will develop a measurement scale and then analyze data from two solutions that are designed to slow down the process of erosion.
7	Students compare multiple design solutions.
8	Students will apply their design solutions to a new sand and water context.
9	Students will optimize their design solutions with the sand and water context in lesson 8.

10. **Design of the Unit and Lesson**

a. The Science

The unit has been designed to carefully develop student understanding of the use of models in real-life through the use of stream tables, sand, and various items to represent real-life solutions to erosion. Students will use this information to understand the big idea of the Earth's surface and how it changes over time. Some of these changes are quick and some are slow processes. These understandings will help them create, in a cooperative group, a model to slow or stop erosion. The stream table will represent Earth's surface and the four items to control erosion will be a tongue depressor for a barrier wall, sponge to represent tree roots, toothpicks to represent grass, and cotton balls to represent sandbags.

B. Cognitive Demand

The unit has been carefully designed so students are using Scientific Inquiry and questioning techniques learned previously during Science and English Language Arts. The progression of the lesson also allows them to apply problem solving strategies learned during Mathematics. The use of investigative teaching techniques helps students rely on their own thinking and the ability to collaborate with classmates that are part of their group. The engineering design portion of the lesson will add to what the students will continually need as they progress through Science each school year.

C. Equitable Access to Content

The structure of this lesson has been designed to maximize the active engagement of all students. The class will all be presented the same problem so that they have all received the same information. During the lesson, students will work collaboratively and will all be given equal opportunity to provide input to their group. This input will be verbal and written. It can be ideas that are shared solutions or justification of their ideas. The group as a whole will use comparison and discussion of all ideas. Time will be taken to compare and discuss the ideas of each group. This will provide every student the ability to hear all of the different solutions with the reasoning behind their choice. This will allow them to see how their model and thoughts fit into the class as a whole.

D. Agency, Authority, and Identity

Students are sharing ideas and making their own design choices in groups. This reflects the actual work of engineering. Through discussion, they build on one another's thinking. We expect that students view themselves as capable to participating in and learning from lessons such as this one.

E. Uses of Assessment

The use of student notebooks will provide ongoing formative assessment. Each notebook will contain student thinking. In this inquiry lesson the teacher will consistently be able to check student understanding, using the notebook. Lesson 6 will also be done as a lesson study lesson. Lesson study will provide documentation by many teachers and this with help support classroom learning in all subject areas. A summative assessment for this lesson will be in the form of note taking during a gallery walk. Using a similar model used during group learning, students will use the same model to assess all models made by each group of learners.

11. **Research Lesson Plan**

In order to facilitate observer's note taking, the lesson plan is formatted differently and attached to this document.

12. **Evaluation**
    - Listen for student talk related to quantity of soil washed away. Are they trying to come up with ways to quantify the amount of soil washed away? Are they discussing the different materials?
    - Listen for students talking about:
        - Material selection
        - Material placement
        - Rationale
    - Observe if students construct the solution according to their plan.
    - Pay attention to how students pour the water. Is it influencing the results?
    - Note what students say as they begin to see soil washing away or not washing away.
    - Note what changes students see first.
    - Note any questions or wonderings students articulate.
    - Are students discussing their noticing using the notebook page?
    - Are students engaging in evidence based argumentation about which design is best?
    - Do students have a shared understanding of how to quantify how much soil has washed away?
    - Are students building off from each other ideas and pushing each other's thinking?
    - Are students engaging in science discourse around changing their design?
    - Note if students are using other designs as a basis for changing their design.
    - Identify any reasons students state for why they think the second design will work better.

13. **Board Plan**
    - Charts that group similar models together.
    - Teachers will premake the rectangle to illustrate the erosion tray.
    - After gallery walk teacher will draw each group's design. Below the rectangle teacher will place the triangle that matches student note taking sheet used to quantify amount of erosion.
    - Teacher will record the students discussions/noticings on the corresponding chart to support students noticing difference between designs and the identification of which design was the best.