Curriculum Resources for Elementary Science Teaching

Compiled by Elon Students in EDU412- Fall 2008

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Spinning Tops

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Ideas and Practices:

1. North Carolina Standard Course of Study Objectives:
    a. 4.02- The student will observe that movement of an object can be affected by pushing or pulling.
    b. 4.05- The student will describe and observe systems that are unstable and modify them to reach equilibrium.
    (Education, 2004)
2. Science Process Skill Statements:
    a. The student will know that objects and systems that turn on a central axis exhibit rotational motion.
    b. The student will know that a force is needed to start a top spinning
    c. The student will know that the amount and position of mass affect how the object rotates.
    (FOSS)

Explanation of Scientific Ideas:

During this process of scientific understanding, it is important for the students to understand and grasp the meaning of rotational motion. In this experiment, students will be working with and observing tops. The motion displayed as a top spins is called rotational motion. Rotational motion is when an object or a system turns around a central axis. Therefore, when an object turns in circles and keeps going around and around, we say that it is spinning or rotating. This is due to the axis that it is rotating around, which causes the circular motion (FOSS).

It is evident that something will not just start spinning on its own. Something needs to happen in order for the rotational motion to begin. This is called a force. A force is exerted onto an object to create movement. According to Newton's First Law of Motion, "every object in a state of uniform motion tends to remain in that state of motion unless an external force is applied to it" (Newton's Three Laws of Motion). An external force needs to be applied to a spinner or another objet of the like before the "action" of spinning or rotating can occur. In other words, someone has to spin the top for it to spin. If a top is just lying on a desk, is it spinning? No. Someone has to exert force on that object, or in first grade language 'spin it', in order for it to do what it was made to do!

Lastly, it is important to understand that the position and amount of mass affect how the object rotates and whether or not balance or equilibrium is maintained as an object is spinning. This simply means that the mass and how it is distributed affects the spinning of the top. In order for an object to spin evenly, the axis of rotation needs to be exactly in the middle because the mass of the spinning object needs to be evenly distributed from the central axis. If not, balance will be lost and there will be uneven rotational movement. That is why rotational motion is defined as an object that moves around a CENTRAL axis.

Description of Children's Conceptions that are commonly Held:

Just like in any concept, children tend to have misconceptions about rotational motion before they learn explicitly about it through experimentation and observation. Four students in a first grade class were asked to explore a top and asked about what they saw. All four students were able to identify the object as a "top" and knew that the purpose of it was to "spin around" or "twist in circles". However, they did not understand that this movement was called rotational motion or that the cause of the motion was the fact that the mass of the top was moving about a central axis. They all also made comments about how the faster the top is spinning, the more balanced it is and overtime, as the top starts loosing speed, it loses balance and eventually stops. When asked "How does the top start spinning?" the students recognized that someone has to start spinning it, which eludes to a force has to act upon it, but they may not have explicitly made the connection that in order for it to move, a "force" has to come into play (class, 2008).

Activities and Resources Useful to Teach Ideas and Practices:

In order to teach students about rotational motion, the first grade science kit found in the classroom will be used. Each student will receive a disk and a shaft to construct a top and explore the factors that enable it to spin and what different things impact the movement of the top they construct. They will get about ten minutes to explore the tops and interact with one another as the teachers go around the classroom asking what they are discovering. After a little while, the teacher will bring the students back together and ask similar questions as a whole class. The class will then have an opportunity to share their ideas and hear the ideas of their other classmates. The questions students will be asked to answer are:

- "What did you use to make your top?
- How do you know when you have made a top?
- How do you get your top to start moving?
- How does a top move when it is working?
- What kind of motion does a top make when it is going?
- What is the best design for a top that spins for a long time?
- What is the best design for a top that spins fast?
- Does it make a difference if you use different size disks?"

(FOSS)

Once a class discussion on these questions or questions similar to this, the teacher is responsible for helping the students synthesize their ideas in saying that "When something turns in circles or goes around and around a lot of times we say it is spinning or rotation. Tops rotate on an axis," which is the shaft we used on this top (FOSS). The teacher will also extend on their discovery on asking what else they see in their everyday lives that have rotational movement and moves around an axis. The teacher will also extend upon the knowledge that a force is needed to begin this type of movement as well as how the amount and position of mass impacts the top.

After reviewing this activity and preparing to teach it to a first grade class, it has proven to be an activity that does point to the values of scientific discovery that teachers should hold highly. This is an activity where students are not told what to do or have an explicit plan to follow, but they are able to play around with the materials they are given and apply their prior knowledge to. They are in an environment where they each have their own materials, yet conducive to work with and gain ideas from others around them. They are able to communicate with one another and build on their schema together. Communication with peers, as we have learned in class, is **vital** when going through the scientific process in order to construct meaning (Reddy, Jacobs, McCrohon, & Herrenkohl, 1998). After they are finished exploring their materials, making their tops, and using them to make discoveries, students are able to come together as a class and discuss what they found, which furthers the communication and discovery process.

According to the 5-E instruction model, this activity seems to fit the criteria. Students will engage in what they already know about rotational motion as well as engage in discovering more. Students will explore using hands on materials and constructing a top that moves in a rotational motion. Then students will be able to explain the things they have found with one another within small groups and whole group. Explanations will be revealed through the things that the students have discovered. Lessons that follow up this lesson will be able to extend evaluate more, even though there is a little bit seen in this lesson (Vasquez, 2008). This activity is one that is worthwhile and valuable to explore in the classroom.

<u>Transforming Content into Teaching—how do theories inform practice?:</u>

Teaching this lesson to first graders was an enjoyable task for me. They seemed to get really into it and through testing and observing the tops they created they were discovering new things about rotational motion. Before we started the lesson, we all sat on the carpet and talked about tops and motion. They seemed to have some background knowledge, but there was still room for discovery to happen. To construct and test the tops they sat in their table groups where they were able to talk and bounce ideas off of each other. By the end of the lesson, through their testing and working through questions I would ask them, they knew what rotational motion was, that all motion starts with a force that is acted upon an object, and things that rotate spin about an axis.

One thing in class that we have talked about is teaching for conceptual change. This means that as a teacher, I am to know the prior knowledge and experiences that they already have and try to build off of that to challenge the misconceptions that they may have. In science, as well as other subjects, it is important that the students are involved in discovering new conceptions. It is my responsibility to provide an experience for them that is guided so that they can discover new things, but without me telling them exactly what I want them to get from the lesson. This makes learning more student focused and interesting for the students.

With this in mind, I wanted to try it out during this science lesson. I gave them an idea of how tops work by giving them the materials and giving them an idea of how to start construct a top. However, the types, sizes and number of disks as well as how far they were apart on the axis was up to them to discover what would give them a top that spun and stayed balanced as it moved. As they were working, I walked around the room and tried to ask the students questions to get them thinking about the science behind the movement of the tops. One of my students called me over and said "Miss Arold, I found the best way to spin it." He showed me; he had his disks close together and towards the bottom of the green axis. I asked him what he thought would happen if he moved the disks up the axis and tried to spin it. He said "You cannot do that because there will be too much weight on top and it will fall over." When he said this, I was excited. We talked about it as a class and I prodded the entire class with questions around that observation. As they kept explaining and I kept asking questions, we had a great discussion as to what our discoveries in this experiment tell us about rotational motion. At the end of the lesson, the students knew that weight had to be evenly distributed around the axis in order for it to spin balanced and that this meant the axis had to be in the middle of the disks. I was very impressed with the knowledge that my first graders accumulated and I really do like this style of teaching for conceptual change. I do want to learn more of how to ask good questions to get them thinking, but I think that comes with time and practice.

The Flow of Electricity

Whyte Carter

1. ***Ideas and Practices:***

Grade 4: 3.03 Design and test an electric circuit as a closed pathway including an
energy source, energy conductor, and an energy receiver.

3.05 Describe and explain the parts of a light bulb.

This includes both knowledge and skill. Students would need to know that:

1. A closed electric circuit is a pathway that channels electricity through wires from one terminal on a battery to the receiver (lightbulb) and from the light bulb back to the other terminal on a battery.
2. The energy source in this experiment is the battery. The energy conductors are the wires. The energy receiver is the light bulb.
3. The parts of a light bulb include: the glass globe, the screw thread, the electrical foot and the filament.

Students would need to be able to:

1. Use trial and error to create a working closed electric circuit using one or two wires, a battery and a light bulb.
2. Observe, take notes and organize what they see taking place based on how they connect the wires to the source and receiver.
3. Draw conclusions about how their tests relate to the knowledge.

2. ***Explanation of scientific ideas and practices:***

An electrical circuit is a circular path that electricity travels through. In order for the circuit to be created, it needs an energy source, where the energy comes from, an energy receiver, where the energy goes and energy conductors, materials that can carry the energy from the source to the receiver. A correctly designed electric circuit connects an energy source (in this case the battery) to an energy receiver (in this case a light bulb) by using two energy conductors (wires) that are touching both the receiver and source. These connections create a circular path that the energy and electricity can travel through and light up the light bulb. In other words, the two wires must go from one end of the source (battery) to the receiver (lightbulb), through the receiver and back in a circle to the source (battery). The electricity flowing through the circuit is continual and does not stop. There may be more than one way to make an electrical circuit that works, so it is important to try different ideas of where to connect the wires to the light bulb and battery.

3. ***Description of children's commonly held:***

All students have had some sort of experience with electricity, whether dealing with the lights in their home or at school, lightening or electronic toys. When presented with the task to create an electric circuit using wires, a light bulb and battery, most students will simply connect one wire from one end of the battery to the light bulb. This is because many students think that electricity is being generated in the battery and will be transferred to the light bulb through the wire. The fact that a complete loop from source to receiver and then back to source is necessary does not naturally enter most students' minds.

One student in my class thought that positive and negative electricity is needed to light the light bulb because he related it to the positive and negative clamps on a car battery (his father is a mechanic). Other students agreed with him and said two wires are required to light up the light bulb. They believed that using just one wire would not work. These students were closer to understanding the scientific concept, but they lacked the understanding of where exactly the wires need to be touching in order for the circuit to work.

Other students believe that the batteries are filled with "juice" and that once all the juice is used up, the light bulb will stop working. This thought is not completely untrue because there are chemicals in the battery that release electrons when a complete circuit is made.

4. Activities and resources useful to teach ideas and practices:

Resource:http://www.fossweb.com/

This is a informational website that goes along with any of the kits produced by FOSS. It provides interactive games for students, resources for parents and extra support for teachers. The website has excellent information for parents to show them how they can practice the science concepts their students are learning at school back at home. In addition, there are links to the research that was conducted in order to create these kits in a way that would be most beneficial to students and teachers. Also, each kit directly relates to standards established by the National Science Foundation and the website provides support for teachers to follow those standards. One of the best resources that FOSS offers is everything they produce(directions, materials lists, parent information, etc.) is available in Spanish.

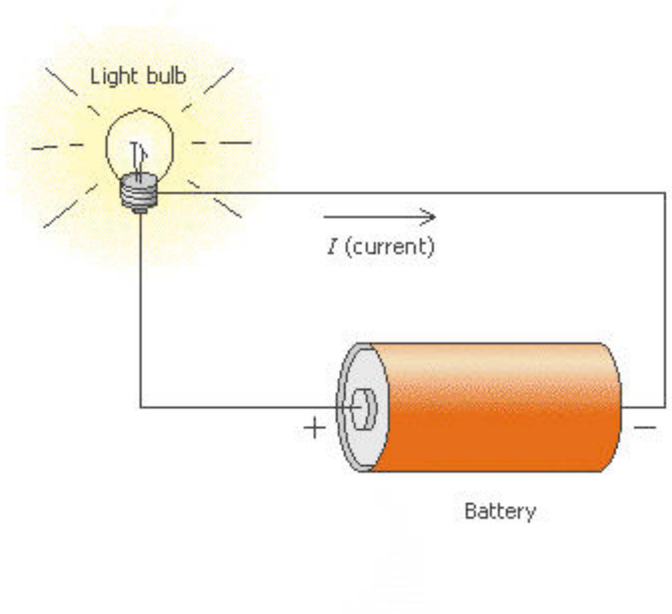
Activity: Lighting a Light Bulb

Materials: 12 D-cell batteries, 12 light bulbs, 24 short wires (20 gauge/15cm), wire stripper, worksheet on electrical circuits

Set-up: strip each wire end before start of lesson, pair up students-each pair will get one light bulb, one battery, two short wires and two worksheets

Before Lesson: Discuss electricity and electrical circuits using a KWL chart, as well as students' prior experiences. Introduce each piece needed to create an electrical circuit. A D-cell battery is a source of energy or an electricity source. It is used in flashlights, radios and other things. A light bulb is an electricity receiver. Use a broken light bulb to show the students the filament inside of a light bulb as well as the other parts of a light bulb (globe, screw thread and electrical foot). The filament is what makes the light because when the electricity reaches the battery the filament gets hot and gives off light. The wires are the energy conductors. They carry the energy from the battery to the light bulb. Explain to students that they cannot get electrocuted from this activity. Remind them that it is unsafe to stick wires in electrical sockets!

During Lesson: Pass out materials to pairs. Allow students 5-10 minutes to explore making an electrical circuit on their own through trial and error. Monitor progress and make note of how many pairs are able to light up their light bulb and the various ways students are trying. Students should also be recording their findings on the worksheet provided. Stop students work after 5-10 minutes and discuss what has happened so far. How many students got their light bulb to work? How did they create the electrical circuit? (Touching one wire to bottom of the battery and the other wire to the top of the battery and then touching the wire to the electrical foot and the screw thread) Is there more than one way? Draw on the whiteboard a picture of what the electrical circuit should look like in order for the light bulb to light up (see below). Discuss where the wires are touching the light bulb and battery. Point out that the current flows from the negative end to the positive end of the battery. Then allow students to mimic the drawing on the board, especially those students who didn't get it the first time.



If time allows/For students that finish early: Challenge students to create an electrical circuit using only one wire.

Conclusion: Review where the wires need to be touching on the battery and light bulb in order to create an electrical circuit and why (electricity must travel in a complete circuit or path from one end of the battery to the other). Discuss and form an understanding that all forms of electricity (radios, tvs, phones, etc.) need an electricity source, receiver and conductors. Collect all materials.

Evaluation: This activity allows students to actively explore electricity and electrical currents through trial and error, as well as in discussion. Rather than telling students what electrical circuits look like, the activity gives the students the necessary materials to create one and lets them do it on their own. Discuss about what worked and what did not and why comes after initial exploration. This is process is allows students scientific freedom to test their previously held ideas about electricity, but also ensures that the students understand the facts and true scientific concepts by the end of the lesson. The students will see first-hand whether or not their beliefs are correct. The science kit provided by FOSS and ABSS uses simple materials to explain a concept that is normally not thought of or seen in every day life. The kit also provides all materials needed, as well as how to set up and lead the lesson. The activity adequately covers the NCSCOS objectives 3.03 and 3.05.

Activity from FOSS science kit: Investigation 2-Magnetism and Electricity, grades 3-4

4. **Transforming content into teaching – how do theories inform practice?**

Even though electricity is ever-present in students' lives, the theories and ideas behind electricity are not as obvious. I approached teaching electricity to my students by asking them what they already knew about electricity and how it worked. Most students thought of Ben Franklin or that you can get electrocuted from touching electricity. Some thought magnets were needed to create electricity. Rather than trying to tackle the students' previously held ideas about electricity through lecture, I immediately allowed the students to start testing different ways to create a complete electrical circuit and light the light bulb. After giving them the necessary supplies to complete the circuit, almost all of the students complained that is would be impossible to make the light bulb work with only a battery and two wires. The students were convinced that some sort of switch or plug was needed. I insisted that they could do and allowed them time to explore and figure out that an electrical circuit was possible. It took about 5 minutes before the first group figured out how to create a working circuit, but when they did, they were ecstatic. I asked them what they had done to make the light bulb light up and they explained to me how they touched the wires to each end of the battery and then to bottom and side of the light bulb. They said they put the wires that way because it made a circle. Gradually, most of the students got their light bulbs working. Then I stopped the class and explained in detail how to make an electrical circuit and drew a picture. I asked different students to explain why the circuit worked. The students understood that a circle was being made that the electricity could flow through and light the bulb. I connected the electrical circuit that the students made to how the electricity in the classroom worked. I explained how the ceiling lights needed an energy source and energy conductor just like their little circuits. At the end of the lesson, I asked the students to draw and write about their electrical circuit and what worked and what didn't work. They also had to describe how a working electrical circuit is completed.

I decided that this lesson should involve more student-student interaction and discussion, rather than me driving the whole lesson. Therefore, I dedicated a large amount of time to allow the students to figure out on their own how to complete the circuit. When some students complained that the activity was too difficult, I replied that science is all about exploring and testing different ideas. Sometimes, scientists fail over and over again before they get the right outcome. I tried to focus on that idea while teaching my class. I didn't want to help them because I wanted them to know what real scientists have to do when experimenting; they have little base knowledge, but keep trying new things and eventually are rewarded with the answer. I think that the students felt much more accomplished when their light bulb lit up because they had figured it out all on their own, without my assistance.

It was kind of hard for me to not guide the lesson more because normally I run a more teacher-in-charge classroom, but I think it worked really well. The students worked hard to figure out the puzzle and realized how electricity really works. We discussed how they didn't get electrocuted and didn't need a magnet or a switch. The lesson took the students' impression that electricity was impossible to create with so little information or tools and showed them how simple this "complex" idea really was.

The Life Cycle of a Seed

Lauren Destasio

Lesson plan modified from original by: Joni Knight

1.
    a. NC SCOS objectives
        i. Science standards
            1. Goal 1: The learner will conduct investigations and build an understanding of plan growth and adaptations.
                a. Objective 1.03: Investigate and describe how plants pass through distinct stages in their life cycle, including:
                    i. Growth
                    ii. Survival
                    iii. Reproduction
        ii. Language Arts standards
            1. Goal 4: The learner will apply strategies and skills to create oral, written, and visual texts.
                a. Objective 4.02: Use oral and written language to:
                    i. Present information in a sequenced, logical manner
                    ii. Discuss
                    iii. Sustain conversation on a topic
                    iv. Share information and ideas
                    v. Recount or narrate
                    vi. Answer open-ended questions
                    vii. Report information on a topic
                    viii. Explain own learning
                b. Objective 4.09: Produce work that follows the conventions of particular genres.
    b. Practices
        i. Science standards
            1. Students will make inferences and estimations regarding the seeds in the brown bag.
            2. Students will investigate plant growth, through observation.
            3. Students will observe the plants the teacher brings into the classroom to see how they adapt to life.
            4. Students will do research (books provided by teacher) at the stages and cycles a plant goes through (growth, survival, and reproduction).
            5. Students will write about their observations of the carrot seeds, using as many details as possible.
        ii. Language Arts standards

1. Students will work on creating oral, written and visual writings through applying already known skills and strategies.
2. Specifically they will be using oral and written language to present information in a logical way, discuss, maintain a conversation on a topic, be able to share information, recount/narrate, answer open-ended questions, report information found on investigated topics, and explain the information learned.

2. The students will be able to strengthen their knowledge in both the science area, as well as, language arts. The science topic the students will be working on in this lesson is the life cycle, specifically growth, survival, and reproduction. The major language arts area that students will be addressing is dealing with strategies in order to work with different types of text.

   Students will demonstrate understanding about the life cycle of a plant, through writing an essay detailing each specific cycle. The students will be showing that they comprehend the information they read because they will have to put the essay in their own words, thus they must have an understanding of the books they are reading.

   A lifecycle is "the continuous changes undergone by an organism in its development from its earliest stage until it is able to reproduce." The specific parts of the life cycle that the students will be investigating are growth, survival, and reproduction, so it is important that the students understand what each of these terms means. Plants reproduce through a process known as pollination. This process is where bees and other types of insects spread the plant's pollen around in the stamen of other flowers. Pollen is the powder that flowering plants produce and when it is transferred to another plant, it leaves the plant's seeds. The stamen is the "stalklike part of a flower that produces and bears the pollen." Survival is "a continuation of life despite difficult conditions." Plants grow occurs when the tiny hairs that are located at the base of the plant that is used to absorb water from the soil.

3. Common misconceptions that children often have about plants and their growth (according to <u>Benchmarks for Science Literacy)</u>:

   Before teachers begin to teach a lesson children often have their own thoughts and beliefs about how things actually work, often time they are misconceptions about that topic. One of the common misconceptions is that plants receive their energy directly from the sun. In actuality, plants use a process called photosynthesis, which is how plants receive energy from the sun to produce sugar. Children also often believe that plants have more than one source for receiving food. The truth is that plants create their own food source through converting light energy into sugar, which is used to help a plant to carry out its life process. They also hold the belief that water, minerals, and carbon dioxide are considered food. As explained above a plant's source of food is the food it creates. Another misconception that it is important to clarify is their idea that plants eat through receiving food via their roots. Children also believe that plants use sun energy for photosynthesis. Energy from the Sun is required for photosynthesis. Another misconception children often hold is that sunlight is eaten during photosynthesis. Lastly, children believe that plants receive water through their leaves, when thorough the process of transpiration water is lost through the leaves.

4. Pre-Activities:
    a. Students would complete a KWL chart about plants
    b. Review sequencing
    c. Review using transition words
    d. Review the life cycle of plants
    e. Go more in-depth about the life cycle of specific trees and plants

Activity: *Life Cycle of Seeds*

a. First students are expected to shake a brown paper bag that contains carrot seeds. Students should be given the opportunity to guess what item is in the bag. Give the students an opportunity to look at the seeds and write down their observations. Students should use specific details of their observations. Next ask the students what they believe will grow from the seed. Mark the student's predictions.
b. Read *The Carrot Seed* by Ruth Krauss to the class. After the teacher has finished reading the book, take the students through it one more time having them pay specific attention to the title and seeds in the illustrations.
c. Have the students discuss the book. Be prepared with questions that would spark conversation among the students.
    i. What if the carrot plant never did grow?
    ii. If you were the young boy in the story, would you give up hope that the carrot would grow, especially since everyone around him told him it would not grow? Why or why not?
d. Discuss with the students the way a carrot seed eventually grows into a carrot. Have the students physically show the teacher how they believe the seed actually will grow.
e. Students will write a fictional narrative about what it would be like to be a seed that is planted in the ground. The students will be expected to give details about their fictional experience.
f. Students will be expected to share their stories with their classmates
g. Students will be asked to write about another type of seed, as a sequel to the *The Carrot Seed*.
h. Students will complete research the life cycle of a plant, taking notes from the books provided by the teacher.

i. Students will write and illustrate the life cycle of a plant.
j. Students will turn in al written aspects of the lesson to be graded by the teacher (according to rubric that children were given before they began).

Resources:

1. Learn NC Lesson Plan entitled *The Life Cycle of a Seed* created by Joni Knight.
2. *The Carrot Seed* by Ruth Krauss
3. www.wordsmyth.net
4. http://wiki.answers.com
5. http://library.thinkquest.org/3715/root2.html
6. http://www.teachersdomain.org/resource/tdc02.sci.life.oate.lp_plantfood/
7. http://www.emc.maricopa.edu/faculty/farabee/BIOBK/BioBookPS.html#What%20is%20Photosynthesis?
8. http://www.kidzone.ws/water/

This lesson plan activity, as well as, the resource is valuable in aiding in student learning. The students not only learn about seeds and the way they grow, but they also have the opportunity to strengthen their writing skills while doing so. The students are supposed to make a logical guess regarding their guess about the contents of the brown bag. The students are also expected to work on their observation skills when working with the carrot seeds as well as while they are listening to the teacher read *The Carrot Seed*. This is a multi-purpose lesson that can be used across science and language arts curriculum.

5. The students participating in this lesson were college age, thus most had a concrete knowledge of how carrots and other plants would grow. The experience was one that was interesting, particularly at the beginning of the less when I asked each student to shake the brown paper bag with the carrot seeds in it and then to guess the contents inside. There were many varying answers, in fact, no two were the same, but none were correct. The guesses varied from food products to arts and crafts material. Conceptually there was no confusion with the information taught during this lesson.

The open-ended questions did not exude more questioning and opinions from the class, partially because of the types of questions. The questions which were "What would you feel if your plant did not grow?" were ones that would have likely sparked discussion among young children, but in this particular arena was answered with blank stares and boredom. These questions are intended to allow students to give their opinions and feelings about something that may have particular interest to them. This may also be a time where students would provide details regarding personal experiences that were similar to those in the book.

When reading *The Carrot Seed* the students had an easy time with the repetition of the words throughout this short book, although not surprising seeing as they were college students. The students were later asked to write a sequel to the book, *The Carrot Seed*, and all of the students that were willing to share their stories were very creative and showed that they had adequate background knowledge regarding the subject area. This specific part of the activity where the students wrote about what they would expect to come next was only a paragraph or less when I presented the lesson, but it would likely be a more traditional story, with the beginning, middle, and end that students are taught to sequence writing in a particular way.

If this lesson were extended to my 3rd grade students there would have been more time and detail devoted to the actual writing of the sequel. The students would have been expected to work with the skills they learned pertaining to writing process and more detail would be expected. I asked the class how they believed that the carrot seed would grow and because these students had a detailed and correct explanation of how the process would work; it is likely that the students would have misconceptions about this process.

Also, if the class had the opportunity to partake in the pre-activities before the actual lesson they would have been more likely to guess the contents of the bag, or at least would have been more in the ball park than the classes actual guesses. The KWL chart would also help to build the groundwork for the information that could be used in this lesson.

Soil

Carrie Dilger

1. *Ideas*

   Grade 3: Objective 2.01 Observe and describe the properties of soil:
   - Color
   - Texture
   - Capacity to hold water

   Grade 3: Objective 2.02 Investigate and observe that different soils absorb water at different rates

   The students will need to either know or discover through investigation:
   - The different properties and characteristics of soil such as: color, texture, capacity to hold water
   - How these different properties feel
   - How the different properties change depending on if we have soil, sand, or clay
   - How characteristics that can be seen and felt through the senses effect the rate at which water is absorbed at

2. *Explanation of Scientific Ideas*

   As the students first investigate soil types, we will be looking at the consistency of the soil. The consistency can be found by trying to mold the soil. Consistency means if the soil will stick together or fall apart. A clay sample will ball up and keep its shape while a sand sample will fall apart easily. The way the types of soil look is related to texture. Texture comes down to how big or small the tiny pieces of soil are. The bigger the pieces are, the more space there is in between the pieces. As we know if there is more space in the soil sample, water will run right through the spaces between the pieces instead of getting stuck between the pieces.

   The three types of soil we will look at are clay, top soil, and sand. They are all made up of different amounts of soil components which could be clay, silt, fine sand, coarse sand, gravel… The samples of soils we will investigate are made up of not one but several of these components. For instance, the clay sample could have mostly clay particles but also some coarse sand particles in it.

   The components of soil have different sized pieces: clay pieces are the smallest, then silt, then fine sand, then coarse sand, and then gravel being the largest. Depending on where the soil comes from and other environmental influences, the soil samples could contain different amounts of these components. How much each sample is made up of these components shows us how big or small the particles of that sample are. One other component that is usually only present in top soil is humus. Humus is organic matter such as plant and animal remains that are being broken down; therefore, humus does not have a specific particle size because it can be made of many different things.

3. *Description of children's commonly held*

All of the children in my class that I interviewed knew there were different kinds of soil. All of them couldn't tell me or describe the different kinds, but they knew all soil wasn't the same. Only one of my students could tell me the names of different kinds of soil, the others described them as "the orange soil, brown soil, or soil with white dots in it". I asked this same student to explain the difference between them and she said that some are soft, some moist, and different plants grow better in certain soils. Another student told me "the kind of soil that's soft" helps plants grow. When I asked students what would happen if water was added to the soil, almost all of them said that the water would go right through.

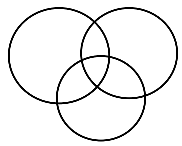
The students are in the middle of a science kit that is about plant growth. Therefore, I think that a lot of the students were pulling from knowledge they have learned recently about plant growth. There are certainly some commonly held ideas that we need to clear up through discovery such as water and its reaction with different types of soil. I also don't think that any of my students consider sand as a type of soil. Through observation and discovery the students should be able to refine their definition and knowledge of 3 different types of soil.

4. *Activities and Resources useful to teach ideas*

This activity was revised from LearnNC.org [http://learnnc.org/lp/pages/3404]
Procedure of Activity:

1) Pass out 3 cups (1 top soil, 1 clay, 1 sand) to groups of 4
2) Students observe the soil, sand, and clay with only their senses (mostly sight and touch)
3) Make a class list of observations from each group separating the notes into columns by soil type
4) Discuss some tests that are possibilities to further explore the three soils
    a. Finger point test – poke your finger into a pile of the soil and see how the pile reacts
    b. Use a magnifying glass to look closer at the pieces of soil
    c. Take a pile and try to mold it into a ball with your fist
    d. Water test – drop the same amount of drops onto the piles of soil and observe how much water is absorbed and how much goes through each type
5) Pass out equipment – magnifying glass, eye dropper, water cup, and paper towels
6) Let students explore and remind them that they can make up their own test to try and learn more about the soil
7) If a group is stuck about what they are seeing or why they are observing what they're observing, they can reference *A handful of dirt*.

8) Come back together and make a 3-way Ven Diagram on the board and they copy.



9) Have a discussion as a class about why we think there are different types of soil and for what purpose. If the class has conflicting conclusions about the soil, as a class either examine *A handful of dirt* or another resource to support the class findings and conclusions.

Resource:
Bial, R. (2000). *A handful of dirt*. New York, NY: Walker & Company.

This book will serve as a resource for the students as they learn more and have questions about soil. The text is fairly extensive for 3rd grade but the language is pretty easy to understand. The author does a great job of relating the information to children's lives. I would not read this book in its entirety to the class because of its length; but this resource would be more useful as a form of reference. The pictures are extremely helpful as well because they are real life images from our outdoor environment or from a microscope to show the properties of soil that cannot be seen with the naked eye. All pictures have captions explaining in detail what the picture entails. The information included in this book is widespread but still detailed enough.

This activity and the resources not only assist student learning but they are required for the "discovery" action the students can experience. The experience I have created for the students directly relates to one of the goals: Observe and describe the properties of soil (texture, color, and capacity to hold water). The students are provided the opportunity to describe the texture, color, and capacity to hold water through actually experiencing the three types of soil. Each group is able to see the water seep down into the pile and watch for the reaction. I also think the ven diagram and discussion at the end will enable them to sum up what they learned and even understand the concepts deeper.

5. *Transforming content into teaching – how do theories inform practice?*

I taught this lesson to college-aged students but it is made for 3rd graders. Had my peers been my 3rd graders, they would have just finished their science kit on plants and plant growth. This lesson is planned as the first lesson in the next science kit which focuses on soil and composting. My 3rd graders don't have that much background knowledge on soil yet. But they do know that it helps plants grow and they connect soil with their plants that are growing in their classroom right now. They will hopefully assimilate information from this lesson about soil into their schema they already have about plants and soil.

One concept we discussed during lecture was Anderson's form of the Scientific Method. The diagram that explained his thoughts was a three-tiered triangle. On the left side was an arrow from bottom to top that represents "Inquiry". On the right side was an arrow from top to bottom that represents "Application". This Soil Lesson follows the Inquiry side where the students begin with Experience and/or Observation and then move to find Patterns and finally create Explanations.

I produced an experience for the students when I gave them the three different types of soils and asked them to observe. During this observation the students built a stronger schema about soil, especially those children that haven't had that much experience playing outside with it. This experience also gives the children a visual picture they can hold in their mind and put into their schema. The best way to learn vocabulary is through creating a visual image you will remember. This activity reinforces not only the words humus, clay, and sand but also how they looked and felt.

As the students went through the different tests they performed, each group made observations about each type of soil. As we gathered back together as a class, the groups were able to share their ideas and a lot of groups had the same results, therefore creating patterns. As we discussed why these patterns occurred and the scientific ideas behind them; the class as a whole came to conclusions and explanations.

As the students were observing and performing their tests, I walked around and talked to them about what they were finding. One group in particular really found a deeper understanding as we talked about why more or less water would seep through a type of soil. One student in particular connected the size of the particles (or pieces) to the amount of space that was between the particles. She then connected the amount of empty space to the amount of water that was seeping through each sample of soil. I thought this was a great connection because the size of the particles and the space between them is an abstract concept. I think I will have to work harder to get this same amount of understanding to my 3rd graders.

The Water Cycle

Carrie Feehan

*I have created this lesson based on the assumption that it will be used within a unit, or series of lessons.

1. *Ideas and Practices:*

Grade 5

Goal 3

Objective 3.01

Investigate the water cycle including the processes of:

- Evaporation.
- Condensation.
- Precipitation.
- Run-off- (not addressed in this lesson)

This includes both knowledge and skill. Students would need to know that:

1. The sun is a source of heat energy that causes water to evaporate (and rise) into the atmosphere.
2. When evaporation occurs, the heat changes water from its liquid form into many smaller particles, (water vapor) that we cannot see.
3. As the water rises and cools off, the gas vapor begins to turn back into a liquid form. This is the process of condensation and also the process of cloud formation.
4. When particles cool down during condensation, they begin to join together again, becoming a smaller number of bigger, heavier drops. The particles that have joined together become too heavy, and begin to fall back down. This is the process of precipitation (rain, sleet, or snow).

Students would need to be able to:

1. Make observations of processes occurring in their model.
2. Draw conclusions about how their observations relate to the knowledge.

3. Be able to connect their observations and classifications of processes to prior knowledge of states of matter, heat rising, cool sinking, run off, recycling etc.

5. *Explanation of scientific ideas:*

The sun is a source of heat energy that causes water to evaporate (and rise) into the atmosphere. This includes water from bodies of water, puddles, the soil, and water that comes out of plants (this process is called evapotranspiration).

When evaporation occurs, the heat changes the water from liquid into many smaller particles, (water vapor) that we cannot see.

As the water rises into the atmosphere, it cools off and the gas vapor particles condense and to turn back into a liquid form. This is the process of condensation. When particles cool down during condensation, they begin to bump into each other, further condensing, becoming a smaller number of bigger, heavier cloud particles.

The particles that have joined together become too heavy, and begin to fall back down. This is the process of precipitation (rain, sleet, or snow).

Precipitation lands in the oceans, other bodies of water and on land. Gravity causes the water to flow across land downhill with some water seeping into the ground and some being deposited into bodies of water. This process is called runoff.

As water moves across the land, it comes into contact with anything in range. Pollution can cause the water to become contaminated. The water cycle is a form of RECYLING something we cannot live without. This is another reason that we must take care of the Earth.

6. *Description of children's commonly held:*

1. Students may believe that when water evaporates, it disappears and no longer exists at all. (Based on interview questions, "it disappears in the sun" then I ask, "so it goes into the sun?" and the student says, "no, I mean the sun makes it go away")
2. Students may believe that when evaporation occurs, water remains in its liquid form, but it moves to another location. (The research base, 2008)
3. Students may believe that since both condensation and precipitation involve water droplets, they are the same thing. (Tool kits, 2007)
4. Students may believe that the precipitation is a new delivery of water to the Earth.
5. Students may believe that particles grow during condensation before they become too heavy and become precipitation.

7. *Activities and resources useful to teach ideas and practices:*

ACTIVITY: This activity is helpful because it gives students a manageable sized model of the water cycle. It displays a real life example of evaporation, condensation, and precipitation. They get to witness the speed of the process, the effect of how much sunlight hits the water. The students can visually see water particles bump into each other, combine, and fall back to where they started.

Adapted from-

The water cycle. (2001). Retrieved October 10, 2008, from University Corperation for Atmespheric Research Web site: http://www.ucar.edu/learn/1_1_2_4t.htm

1. **Opening conversation**-
   What do we use water for? Where do we find water in nature? How come the earth doesn't run out of water when we use it for so many things? Where does snow go after it melts? Where do puddles of rain go?

2. **Review Terms by visiting site:**

- **Water Cycle Animation:** This resource includes a diagram that illustrates the different processes involved in the water cycle, how they occur, and how water changes form throughout the cycle. The diagram shows movement such as, evaporation, condensation, precipitation, run off, and infiltration.

Visit: http://earthguide.ucsd.edu/earthguide/diagrams/watercycle/index.html

3. **Give directions-**

   Each group comes up to get a clear container (filled with a little warm water), a rubber band and a piece of saran wrap.

   Carefully carry this back to your desks and make a tight seal over the mouth of the cup with the plastic wrap.

   Put the rubber band around the wrap to ensure it stays in place

   Place ice cube on top

   Bring the cup to window sill/under lamp to serve as the sun.

4. **Review observations**, making sure to discuss the following-

In **question form- which part simulated evaporation, condensation, precipitation?**

Points:

- The water we put in the bottom of the cup has begun to rise up to the saran wrap, **evaporation**.
- The ice cube makes the top cold, just like how cold the clouds are up in their high altitude. This cold temperature turns the vapor back into liquid drops, **condensation**.
- As condensation adds up, drops bump into each other and become one bigger water droplet. When it gets to heavy, it falls back down, **precipitation**.
- The amount of water on Earth remains fairly constant because of this cycle. The amount of water in the bottom of our model stays about the same, by the time drops begin to fall, more drops have formed on the saran wrap after evaporating from the bottom.
- What water cycle step that we're studying did we leave out of our model? How could we change the experiment to include an opportunity for run off?
- So is the water cycle a form of recycling? Both are cycles. How do run off and recycling water relate to pollution? (If the ground is polluted, our water will be too!)

5. **Enforce ideas with song:** this song is helpful for students to help them remember the names of the stages included in the water cycle. They can become comfortable with what occurs in each stage through the activity, and then reinforce the process terms with this catchy tune.

- **Water Cycle Stages Song:**

(Sang to the tune of She'll Be Coming Around the Mountain)
Water travels in a cycle, yes it does
(use pointer finger to make a big circle)
Water travels in a cycle, yes it does
(repeat finger circle)
It goes up as evaporation
(moves hands up to the sky
Forms clouds as condensation
(make a cloud overhead with arms)
Then comes down as precipitation, yes it does!
(sprinkle with fingers while bringing arms down in front of you)

8. *Transforming content into teaching* – how do theories inform practice?

One of my main goals in creating this lesson was to promote students to come to their own conclusions about what was going on in our model. The only information that I gave the class about the model they were creating was that the water represented water on Earth, in the ground, in bodies of water, and in plants. I asked the students to provide me with their observations and then I asked them what they thought was going on with everything they saw. I asked them what they physically saw, what it might look like on Earth, and what process it represented in the water cycle.

I included certain questions to help me assess their knowledge and to reinforce my point of letting them use prior knowledge and observations to figure out what was happening. One example of this was when students told me that they saw water particles on the plastic wrap. I responded to this observation by questioning where the water came from, "did it seep in from the ice cube on top?" I knew that this was not the source of the condensation they were seeing, but I wanted to stimulate their thinking about possibilities and assess their connections to prior knowledge.

One of the observations that I would like to see students make on their own, if this activity were used in a real classroom (over a longer period of time) would be that although the water cycle is, a cycle of events, these processes do not occur in a definite, sequential order. Weather conditions vary all the time and this experiment displays that sunlight is an important variable in the water cycle. Along with this relationship between weather and the water cycle, students would be able to conclude that what occurs in one location will be different than what is happening in other parts of the state, nation, and world.

I think that this activity gave students the chance to understand several aspects of the water cycle, watch them occur, make connections to how the water cycle affects them and recognize how their actions can impact future access to fresh water. The song and animated diagram are useful because they will help the students to remember the names of the steps in the water cycle, but it is the conclusions that students made based on their own observations that will stick with them as knowledge that is their own.

Bees & Flowers

Jasmyne Hill

Ideas and Practices:

<u>NCSCOS Objectives</u>

1.02 Observe and describe how environmental conditions determine how will plants survive and grow in a particular environment

1.05 Observe and discuss how bees pollinate flowers

<u>Practices</u>

The students are supposed to know characteristics of honey bees and how their bodies aide their jobs within the colony. They should take note to what characteristics are important for pollination such as the hairs covering the bee's bodies that trap pollen. They will need to understand the roles of the three types of bees as well.

The students will be need to be able to access prior knowledge and record information about bees. They will make observations of dried bees, including drawing and diagramming for their notes. They will also discuss, brainstorm and formulate questions they have prior to learning about bees. They will use materials to construct bee sticks for future pollination.

Explanation of scientific ideas and practices:

This lesson follows up students on what they are learning about plants and how they grow. It helps students explore bees and their contribution to pollinating plants. Students will recall prior knowledge, ask questions, and uncover answers about bees. They will observe and draw their bees before getting them ready for pollination. This lesson helps students use what they know to collaborate and draw conclusions about bees and pollination.

Bees play an important role in nature in many ways. They produce wax, provide honey, and help with pollination. The lifestyle and physical characteristics of bees makes it easier for them to do all they do. The three types of bees that live in a colony are the workers, drones, and the queen. Their bodies are made up of three parts, the head, thorax and the abdomen, but because all the bees have different jobs their bodies have evolved in different ways. The queen bee is the only one of her kind in the colony. She is the largest bee in the hive and lays about 1,500 eggs a day. The queen lives for three to five years and then a new queen is hatched. The drone is wider and thicker than the queen, is a strong flier, and is always male. Drones make up only ten percent of the hive and they only live to mate with the queen. The worker is always female, and is the smallest bee. They make up ninety percent of the colony's population. These bees do all of the work from collecting food, hatching the eggs, protecting the hive, and transporting nectar and pollen. Pollination, transporting pollen between flowers, helps them to produce new plants.

Description of children's commonly held:

It was interesting to see what ideas and perceptions the students already had coming into this lesson. They had briefly discussed bees, mostly focusing on their body parts, so majority of the students knew to point these out. The students included information that they obtained from past experiences with bees. For example, one student explained that he knew bees died after stinging because he observed the bee's stinger still left in his arm, and afterwards the bee died. After they filled in what they knew on their circle charts they wrote down questions they wanted to find out. Some include "how do bees eat, can killer bees really kill, and how old can bees live to be? After writing their questions underneath their circle charts they began observing their dried bees. One student took of the thickness of the bee's fur and exactly how "fuzzy" they were. Another student made the assumption that bees must not bleed, or have blood because when they were gluing/sticking the bees to the toothpicks they remained dry. I don't think any of the students concepts changed but I do think they added information to their schemas on bees.

Activities and resources useful to teach ideas and practices:

This lesson is best taught to small groups that way students can collaborate and observe together. The students will need their science notebooks to take notes and make observations. They will also need specific science materials for this lesson including: dried bees, toothpicks, trays for the materials, forceps, magnifying lenses, student science handbooks, glue, and Activity Sheet 4 (How to Make a Bee Stick).

First have the students construct circle charts to process what they already know about bees. They should fill in the circle with characteristics and information they have from prior knowledge. Underneath the circle chart, have the students write questions about what they hope to learn about bees or what they are curious about. It's ok if they collaborate and brainstorm questions together. After they have given what they know provide them with information about the lifestyle and physical characteristics of bees.

Next its time to actually create the bee sticks. Have all the materials out and distribute on a tray, a dried bee, forcep, toothpick, and hand lens. The students should also have the activity sheet that explains how they are to create a bee stick. First have them observe and take notes on their dried bee. Encourage them to make drawings and label descriptively. When they are finished, make sure they have their activity sheet which gives them student specific instructions to create their bee sticks. They will be gluing their dried bees to the tips of toothpicks so they can pollinate their plants later. Once they have their bee stuck to the toothpick have them poke their finished bee sticks in an inverted cup for storage. When they are finished collect all unused supplies and have the students clean their areas. To close ask students were any of their questions answered after observing and learning about bees and their characteristics. Provide them information about the next science lesson coming up and what will be done with the bee sticks for pollination.

There are many resources or extensions that can aide in this lesson. Many students have questions about killer bees and the book Killer Bees by Marcia Hines explains the differences in behavior and appearance between European honeybees and Africanized honeybees. It also provides an additional photo diagram with all the bee's body parts labeled.

Insects of North America by George C. McGavin is a good resource to use with the students to provide them with an encyclopedia of information on insects in general. Students can learn for themselves some of the main similarities and differences within the species. They can also use this resource for research for extension activities about other insects. It provides information for students to compare and contrast on all North American bees such as the Leaf-cutter, Mason, Cuckoo, Digger, Carpenter, Bumble, and Honey bee.

Another resource is the book Insectlopedia by Douglas Florian. It consists of poems and paintings inspired and dedicated to different insects. This allows students to not only relate bees to other insects, but gives them a language arts/literature connection. Students can explore other insects in a creative, unique way. They can also be encouraged to create their own poems or expressive literature.

Transforming content into teaching- how do theories inform practice?

Initially after teaching the lesson, I was worried that not enough time was given to the concepts that I presented with the information from the kit. The students did a great job collaborating on their previous knowledge about bees, but I didn't spend the same amount time covering all the information. I didn't want to simply read the pages to them, so I covered main points about the specific types of bees and their jobs. I wasn't sure how to introduce in the mating facts, so I left that out

Due to fact that the lesson was placed as a center during guided reading the students rotated to me as a center. I tried to keep the pace moving so the students could complete the lesson before it was the next group's turn. Most of the students were excited about the lesson but coming from their guided reading centers their minds were not exactly on science, and many had seen the dried bees we were going to be gluing so they were intrigued for the hands-on component.

On the day I did this lesson I wasn't aware of the follow up lessons that were going to come a few days later. I was worried that the students would loose the information that I taught them in such a quick manner. I was only able to explain the three types of bees' characteristics and roles they play inside the hive. The discussion was pretty brief and barely covered the process of pollination. It was a set up lesson that would have the students pollinate and then learn the ins and outs of the process. They received additional lessons and worksheets in the next couple of days that further explained the three types of bees, their habits and their role in pollination in vocabulary suited for their independent or group completion. Once I realized that they were going to get more opportunities to explore the ideas of pollination and bees I wasn't so worried about the lesson I taught. In the scheme of things the first lesson was constructed to get their ideas flowing.

After reviewing the article by Kathleen J. Roth I have to agree that "children's learning of science must start with their own experiences and with their own stories". The students really communicated and collaborated about what they knew about bees. They felt free to tell different experiences they have had with bees which provided them with the knowledge they had. It really does help when they are comfortable with the ideas and processes of science. Having them ask questions and invent answers can really be the building blocks of what information to guide them towards. It also helps clear up misconceptions and incorrect information. (Roth)

Plant Structures and Functions– Grade 3

Kate Hinkle

1. **Ideas and Practices:**
   Competency Goal 1: The learner will build an understanding of plant growth and adaptations.
   Objective 1.03 Investigate and describe how plants pass through distinct stages in their life cycle including:
   - Growth
   - Survival
   - Reproduction

   Objective 1.05 Observe and discuss how bees pollinate flowers.

This includes both knowledge and skill. The students will need to know:

- **i.** **T**he reproductive parts of a flower including; the stamen, pistil, petal, anther, and ovary.
- **ii.** How cross pollination occurs and what animals in nature are part of the pollination process.
- **iii.** That plants have certain structures that serve specific functions

Students will be able to:

- **i.** Distinguish the structures of a flower by drawing and labeling a picture
- **ii.** Take apart the individual parts of a flower to eventually uncover the new seeds in the ovule
- **iii.** Make observations of the reproduction components and connect it to the knowledge they have of cross pollination

2. **Explanation of Scientific Ideas and Practices:**
   - **i. Cross Pollination –** Cross Pollination is the moving of pollen from plant to plant by the wind or bees. The pollen is made in the stamen and moves to the top of the pistil. When the pollen is in the pistil, bees and other animals come by and eat the nectar, a sticky sugar, and the pollen rubs off onto their bodies. Then, when the bees fly away and visit other plants, the pollen falls into those plants, and reproduces to makes new seeds, and therefore new flowers.

   ii. Plant Structures – Every plant has specific structures that are essential to the plant's survival. The pistil is the female reproductive part of the plant that includes three parts; the stigma, style, ovary. The stigma is the sticky part in the middle of the flower that we see if we look down into the plant. The stigma is connected to the style which is like a tube for the eggs to travel in before getting to the ovary. The male reproductive part is the stamen which is the structure that produces the pollen. This is a very important structure in relation to pollination. The petals are also an important structure that relates to cross pollination because their bright colors attract pollinators such as bees and birds. As we take the flower apart we see a structure called the sepal which acts as a protector of the developing buds.

3. **Description of Children's Commonly Held Ideas:**
   i. Children often have misconceptions when it comes to scientific concepts. Students either make inferences about these concepts from what they hear, and from other concepts they have learned. They often apply other aspects of science and create ideas in their head they might not necessarily apply. From a variety of resources and interviews I have come to learn some of the misconceptions that children have regarding plants. For example, some students think that plants absorb water directly through their leaves. Also, many students believe that plants absorb food directly through their roots. They do not believe that a plant can manufacture their own food. The most common misconception is that children believe plants and trees are not living. After examining and learning about plant structures, we know that plants are alive and function as a living organism. Many of these misconceptions entail correct elements of plants and plant life, yet they don't have all ideas correct.

Berthelsen, B. (1999). Students Naïve Conceptions in Life Science. MSTA Journal, 44(1) (Spring'99), pp. 13-19. http://www.msta-mich.org

Sedely, Rose, M. Correcting Misconceptions in Science. Microsoft PowerPoint, U.S. Department of Education.
https://www.t2tweb.us/Mgmt/TTC/SessionFiles/S0086-F02283.pdf

j. Activities and Resources Useful to Teach Ideas and Practices:
The activity that is integrated into this lesson puts the knowledge the students have learned into picture and print. There will be a hands on component which will then connect to the final product.

- TTW show the students a picture of a full grown Alstromeria flower. TTW point out the reproductive parts including the stamen, pistil, petal, anther, and ovary.
- TTW then pass out an Alstromeria to groups of three (in a third grade class I might give each student a flower for a more clear visual).
- Once all groups have a flower the TTW instruct the students to remove the pieces one by one. TTW remove a piece, and then the

students will follow. TTW remove all pieces, while reiterating the function, until she gets to the ovary.

- TTW instruct the students to carefully open the ovary and observe the seeds inside.
- TTW review the function of each part of the flower and be sure that all students are clear which part is being addressed by pointing them out on the labeled picture
- TTW then pass out a picture of a flower and have the students label each part
- On the back TTW instruct the students to draw three pictures in boxes of what they observed when taking apart the flower – the full flower, the stamen and anthers, and finally the inside of the ovary including the seeds.
- After the students have completed their pictures, TTW informally assess the students by calling on various children to share their observations. TTW be sure to point out the differences in observations that students have made.

Additional Resources: The Plants Parts series by Vijaya Bodach is a six set series on different plant parts and are titled *Roots, Seeds, Flowers, Fruits, Stems, and Leaves*. These books are wonderful resources for a variety of ages. They are very straightforward and include wonderful illustrations of the various plant structures. The book that would correlate the most appropriately with this lesson is *Flowers.*

Bodach, Vijaya (2007). *Flowers*. Mankato, MN : Capstone Press.

k. Transforming Content into Teaching- How do Theories Inform Practice?

I taught this lesson on October 13, 2008 to my Methods II class. I thought today's lesson was a good way to put the theories we have learned in class, into practice. Previous to teaching the lesson I was worried that since I was presenting a fairly simple topic to college level students, I would not receive that "a-ha" moment. To my surprise the class responded extremely well to the learning objectives that I was trying to present. Seeing as two out of three teachers engage in hands on learning activities, and these students outperform their peers by more than 40 percent above grade level in science (Vasquez,5), I figured a hands on approach would be most effective. The class was extremely engaged in the hands on activity and made it clear that physically working with the flower helped them better understand how the plant structures were connected, and it gave them a high quality visual as to how each structure aids in the plants performance.

The most important theme of this lesson for me was building on my students' prior knowledge through a hands on approach. I think I provided students with an experience so that they were able to relate to the topic, as well as build on their previous knowledge of plant growth and pollination. Most of the students knew, or were somewhat familiar with the flower parts, but they had never had the chance to deconstruct a flower and really examine the different parts and function. Most students had only read about these ideas, and I think this lesson gave the students an opportunity to bring text they had previously read about plants and apply it to real life. I think connecting text to real life is extremely important when teaching science.

Although it was not exact, I think my lesson also followed the 5-E Instruction Model to help students understand this concept. Previous to starting the lesson I *engaged* the students by asking if they knew various parts and functions of a flower. Next, the students *explored* the ideas of plant growth and pollination through the deconstruction of the flower and discussion. Then, the students sought to *explain* exactly how pollination occurred through the parts that they just examined. After discussing and seeing the different parts of the flower, I challenged and *extended* the students thinking by having them draw the steps of the deconstruction and what they saw. This extended the students thinking from whole flower to part flower and really broke down the function of each component. Lastly, I *evaluated* the students understanding through informal assessment. I asked the students to describe their pictures and what each picture represented. The students were able to reiterate the important parts of the flower and clearly stated the function. Overall I think the lesson had a great deal of learning to it. Students were able to apply what they knew, to what they were seeing.

Comparing the World's Biomes

Kirsten Holtje

1. *Ideas and Practices:*

   Grade 5 Competency Goal 1: The learner will conduct investigations to build an understanding of the interdependence of plants and animals.

   Objectives:

   1.01 Describe and compare several common ecosystems (communities of organisms and their interaction with the environment).

   1.02 Identify and analyze the functions of organisms within the population of the ecosystem:

   - Producers.
   - Consumers.
   - Decomposers.

   1.03 Explain why an ecosystem can support a variety of organisms.

   1.04 Discuss and determine the role of light, temperature, and soil composition in an ecosystem's capacity to support life.

   1.05 Determine the interaction of organisms within an ecosystem.

Students would need to know that:

- The world is divided into six major kinds of large ecosystems, called biomes.
- Each biome has it's own unique climate, soil, plants, and animals.

Students would need to be able to:

- Research the taiga and grassland biomes in the provided books.
- Find and list characteristics of the taiga and grassland biomes.
- Present these characteristics to the class.
- Compare and contrast the taiga and grassland biomes.

2. *Explanation of scientific ideas:*

   The earth is divided into six major ecosystems. These large ecosystems are called biomes. Each biome is very different from the others. Biomes differ in the types of plants and animals found there. They also differ in the climate, or average weather, and in the type of soil found there. Each biome has a unique combination of these characteristics that allows certain forms of life to survive there.

One biome of the world is called the taiga. Taigas exist in the Northern Hemisphere, mostly in Alaska, Canada, Norway, Sweden, Finland, and Russia. The taiga is known for it's coniferous forests. Coniferous means that its trees have needles instead of leaves and often produce cones, like the spruce, fir, evergreen, and pine. Because the decayed needles fall from the trees and lie on the surface of the ground, the soil here is poor in minerals and often acidic. You would find animals like rodents, snowshoe hares, lynx, sables, ermine, caribou, bears, wolves, and moose in the taiga. You might see birds in the cool summers, while the winters are very cold, too cold for birds. This region also receives about 20 inches of rain per year, a moderate amount, and lakes and ponds are common.

The grassland is another biome found on our planet. Grasslands are located mostly in the interiors, or toward the center, of continents like North America, Africa, and Australia. Each country's grasslands are slightly different, but they have many common characteristics. These areas are cool in the winter and hot in the summer. They receive about 10-30 inches of rain per year and have a rich topsoil. This fertile soil allows many types of grasses and small shrubs to thrive here. In America, much of this land is used for farming because crops, such as wheat, corn, and oats, grow so easily. You won't see many trees, except near some sources of water. In the grasslands of America you would find animals like prairie dogs, foxes, wolves, buffalo, snakes, insects, and various birds. Elephants, giraffes, lions, zebras, wildebeests, cheetahs, and hyenas are found in Africa's grasslands.

References:

Kalman, B. (1998). *What is a biome?* New York: Crabtree Publishing Company.

Moyer, R., Daniel, L., Hackett, J., & Baptiste, P., Stryker, P., Vasquez, J. (Eds.). (2000). *Science*. New York: McGraw-Hill.

Sands, E. (2002). Ecology. *Kids Discover*, 12 (2), 4-5. New York: Kids Discover.

3. *Description of children's commonly held ideas:*

Prior to my lesson, I informally asked several children in my class about ecosystems, which they have been studying. I asked them to define an ecosystem and to tell me the parts of one, which they were able to do successfully. They effectively used words like producer, consumer, and decomposer. They were also able to accurately tell me about food chains and the basic ideas regarding the transfer of energy between organisms within a food chain. I believe that several common conceptions about ecosystems and food chains as listed by Leach, Driver, Scott, and Wood-Robinson (1996), such as "organisms get their food and water from human beings," were probably dispelled by my CT in previous lessons. My lesson about biomes was designed to build on these ideas and introduce a wider lens through which to view the world from an ecological standpoint.

Reference:

Leach, J., Driver, R., Scott, P. & Wood-Robinson, C. (1996). Children's ideas about ecology 2: ideas found in children aged 5-16 about the cycling of matter. *International Journal of Science Education*, 18(1), 19-34.

4. *Activities and resources useful to teach ideas and practices:*

Activity:

For my lesson, I decided to have the students compare and contrast two biomes of the world after a brief introduction of the topic. I will begin by asking the class about ecosystems, since that is what they have been studying:

- Can someone tell me what an ecosystem is?
- Is there only one kind of ecosystem or are there many?
- Can one single ecosystem be found all over the world? Why or why not?

Then, I will have them turn to pg. 160 in their science textbooks. I will explain that the earth can be divided into 6 major ecosystems, called biomes. I will have them note that each color on the map represents a different biome and we will locate each biome as a class. I will explain that each biome has its own unique climate, soil, plants, and animals. I will ask the class if they can define climate. To clarify their answers, I will use the examples of desert and rainforest. I will also pose the question that if each biome is one large ecosystem, what does that mean each biome will contain? I want the students to relate their knowledge that an ecosystem contains consumers, producers, and decomposers to the fact that a biome will also have a unique set of each of these categories.

For their activity, I am going to break the class into two groups and have them each research one biome, focusing on the taiga and grassland biomes. They will focus their research based on five topics within their biome:

- List 3 kinds of producers found in your biome.
- List 3 kinds of consumers found in your biome.
- Describe the climate in your biome. What is the average temperature and rainfall?
- Describe the soil found in your biome.
- Where is your biome located in the world? On which continents or in which countries?

Within their groups, I will divide them into pairs or groups of three and have each pair research one of these topics about their group's biome. This will allow them to focus their research and more easily complete the task within the allotted time. Once I divide the students into their groups, assign partners, and distribute research topics, the students will have about 10 minutes to find the information in their textbook, photocopied pages from the *What is a Biome?* book, and photocopied pages from a *Kids Discover Ecology* magazine.

Once they have all completed their sheets, they will share their information with their group. Once the groups have shared within each other, we will come back together as a class. I will have each group share on each of the 5 topics on their biome.

After the groups share what they have found, we will create a Venn diagram comparing and contrasting the two biomes as a class. I will have students contribute information that they learned and place it in the correct portion of the diagram that I create on the board. The students will also be filling in a diagram of their own to keep for notes. Our completion of the Venn diagram will end the lesson.

This activity will help students learn about biomes in general and the taiga and grassland biomes more specifically, as part of the entire Grade 5 Science Competency Goal 1. By looking at the map during this activity, students will learn that the world is divided into six major kinds of large ecosystems, or biomes. By relating this information to their prior knowledge of ecosystems, students will understand that each biome also has its own climate, soil, plants, and animals. During the research part of this activity, students will be using provided materials to find and list characteristics of the taiga and grassland biomes, to serve as examples of the major biomes of the world. By providing each pair with specific information to look for, I am helping them focus their research and assisting them in picking out the important facts from a more inclusive resource. Students are gaining presentation skills by sharing their findings in a supportive whole-class setting. When we create a Venn diagram as a class, I am modeling a familiar compare/contrast technique, while the students are being pushed to synthesize what they have learned about their group's biome and the other group's biome. At the same time, the students are creating an accurate and more concrete product in their notes to which they can refer later.

5. *Transforming content into teaching – how do theories inform practice?*

When I taught this lesson to my 5th grade class, I began by activating their prior knowledge by asking questions about ecosystems, which I knew they had been studying. I used these questions to lead them to thinking about biomes, the new topic I introduced in my lesson. After explaining a biome in relation to an ecosystem, I broke the students off into groups to have them do the research activity I planned. The students worked really well and several groups were able to provide more information that I asked of them on their worksheets. I had to guide some pairs to where they could find the information they were responsible for finding, but ultimately, they all did a great job. When we did the Venn diagram, I was impressed with how many facts they were able to generate for each biome. Some students were even contributing information about the other group's biome. I had a chance to explain more about biomes, climate, and define biome-specific vocabulary during this whole-class activity time, as well.

During the group-work time, I had one student come up to me with a very intelligent question. I had worked with the student before in lower-level small groups in math and reading, so I was impressed that she was thinking so hard about biomes. She asked me what would happen if you took out some of the living organisms from one biome and put them in another biome. I asked her to elaborate on what she meant, so she gave me an example. She said, "Well, what if you took the plants from the taiga and put them somewhere else?" "Like the desert?" I clarified. She nodded. So, I turned the question around and asked her what she thought would happen. She told me that she didn't think the plants would be able to survive because the soil wouldn't be the right kind. I told her she was exactly right. I asked her if there were any other reasons that a plant from the taiga wouldn't survive in the desert. She mentioned the temperature being too hot, but couldn't seem to think of any other reasons. I mentioned that maybe it wouldn't get enough water in the desert since that biome gets less rain, and she agreed. Then she asked me what would happen to the taiga if you took a plant out of it. She told me she thought that the consumers who ate it wouldn't have anything to eat. I also mentioned that if any animals lived in the plant, like a tree, that they wouldn't have a home any more. She concluded that this would be a bad thing because the consumers would die and it would affect the whole ecosystem.

Looking back, I should have had her repeat her question so that the class could have a chance to hear it and discuss what they thought would happen. Even though this whole exchange took only a minute or two, I could tell that she was processing the information at a higher level by applying what she knew about ecosystems previously to what she was learning about biomes and even to biomes we hadn't explicitly discussed. She was able to answer her own question for the most part by talking it out and by applying what she already knew to a new situation. I also helped her by modeling the thinking process she should take and by probing her with more questions that she could answer, ultimately leading her to the answer of her first question.

I don't think the class had any prior conceptions about biomes explicitly themselves before my lesson, so I can't say I changed any of the children's conceptions during this lesson. It was more about adding to what they had just learned about ecosystems and applying it in a larger sense to the topic of biomes through my planned activity. I could tell that in the instance I described, the student was doing exactly that, even beyond the boundaries of my lesson.

Wheel and Axle

James Homan

Ideas and Practices:

Grade 1 Competency Goal 4: The learner will make observations and conduct investigations to build an understanding of balance, motion and weighing of objects.

O**bjectives**

4.01 Describe different ways in which objects can be moved.

4.03 Investigate and observe that objects can move steadily or change direction.

4.04 Observe and describe balance as a function of position and weight.

4.05 Describe and observe systems that are unstable and modify them to reach equilibrium.

This includes both knowledge and skill. Students would need to know that:

1. Wheels roll down a slope.
2. A slope is a surface that is higher on one end.
3. Axles support wheels.
4. Wheel-and-axle systems with wheels of different sizes roll toward the smaller wheel

Students would need to be able to:

5. Make observations of how a wheel and wheel-and-axle system rolls.
6. Draw conclusions about how their observations relate to the knowledge.
7. Be able to build a correct wheel-and-axle system.
8. Set up a proper slope.

Explanation of scientific ideas and practices:

Since gravity pulls everything towards the center of the earth, if anything is not sitting on a flat surface and has room to fall, it will. When something is sitting at rest on a flat surface it does not go anywhere. Other than just falling through the air, some things are also able to roll. Since an object falls from a higher surface towards the ground, it is the same when a wheel is rolling on a slope: it needs to go from the highest part to the lowest. 1st grade students can be just like scientists when they see this because they see this every day. When a desk is tilted and a pencil rolls off, this was because the platform was no longer flat, so gravity pulled the pencil off the desk.

Wheels are typically taller than they are wide, meaning they are able to fall over easily. However, if we put another wheel a distance apart from it and attach them with an axle, they hold each other upright and stay straight because both wheels are forced to go in the same direction. Everyone can observe this because of how a car could drift forever as long as the steering wheel was straight. If a bike was pushed, though, it would eventually fall over because it does not have another wheel with an axle attaching the two.

The wheel and axle going straight only works, however, when both wheels are the same sizes. When two wheels are the same size, it takes the same amount of distance to do a complete roll. When one is smaller, it takes less room for it to do a full roll. If you think about having you and your dad do a somersault, your dad will land farther than you will after completing it. If different sized wheels are going at the same time with an axle attached, imagine as if the bigger wheel is trying to catch up the smaller wheel, so it goes a lot faster. What ends up happening is the whole unit ends up rolling towards the side of the smaller wheel. Scientists might try this by putting two different sized wheels on a car to see if it rolled straighter. People also must have wondered why everyone on the outside lane of a track was losing in races, and they realized it was because they had to run farther than those on the inside!

This is a nice explanation; did you use any resources to help you develop the explanation?

Description of children's commonly held:

In regards to a wheel going down a slope, the 1st graders I talked to seemed to understand some of the basic concepts, but had trouble putting all their ideas together. For instance, one of the simpler ideas such as how a wheel rolls down a slope from top to bottom was easy for them to understand. They seemed to grasp the concept of gravity since they see it everywhere and have probably dropped their toy cars off of tables and seen a ball roll down a hill. Although they might not be able to define gravity, they understand what it is. When asked if a wheel will nicely roll down it, they said yes. However, after a few seconds and me questioning them further by asking more specifically if the wheel will continue to stay up as it went on the flat ground, a couple corrected that and said it would eventually fall over. I then brought out another wheel and an axle asked them what would happen if I put them together, and one or two recognized that they would roll perfectly straight. After some more asking as to why that would happen, the students were trying to get at saying the wheels were supported by the axle, but they never were really able to get to that point. Overall, the first graders seemed to be able to generally understand the concepts of this lesson based from their own experiences of seeing and feeling gravity, and seeing cars, trucks, etc. on a regular basis. Their knowledge of these concepts has never been developed or discussed, so their ideas were very basic.

Activities and resources useful to teach ideas and practices:

a. After getting instruction of the ramp out of the way, I will pass out the big red wheels.
    i. Predictions will be briefly talked about as to what will happen when they roll the wheels down. Will they stay up?
b. Have students take turns rolling wheels down and observing them fall over at the end.
c. Pass out axles and discuss what it is.
    i. More predictions as to if it will be better, worse, etc.
d. Take turns rolling down ramp and observing.
e. Introduce small yellow wheels.
    i. Hypothesize and predict about one large and small.
    ii. Encourage students to try and make trick combinations like wobbly rollers, one that goes back and forth, or a new one they find.
f. Talk about results and why they happened.
g. Ask if anyone did two small yellows with nothing else.
    i. If not, ask what they think will happen
    ii. Go over ideas of the wheels being even.
h. Finish with discussing overall ideas of why wheel and axles work, different combinations and what they do, etc.

This activity is excellent for figuring out these different ideas in technology. An example why is how students really can see how the wheels need to be even on both sides of the axle because of their experiments using two small and two big wheels. When starting with two big and then going to one big and one small, they might get the misconception that the yellow ones make the wheel and axle turn. However once they see that two yellows work, they can realize that it depends on if they are even on the ends, and not on the size.

The resource used for this science lesson activity was the FOSS balance and motion science kit. It is an excellent resource for this lesson and many others dealing with different and similar topics. Overall the kit contains numerous materials but this specific activity included green plastic straws for the axles, two sizes of wheels, and ramps. The resource was very thorough in its ability to help with instruction due to the wheels. Some regular materials might just have two different sized wheels with one position in the middle to put the axle. The wheels in this resource had three different positions to place the axle, including slots on the outsides of the wheels to fit another axle. These were so important in the children's experimentation because it showed what other possibilities could come out of using a wheel and axle system, and why two same-sized wheels yields the best possible results for rolling wheels.

An excellent resource to help in teaching wheel and axle systems is a book called *What is a Wheel and Axle*, by Lloyd G. Douglas. It is a children's book that has great explanations and then some examples to follow. The first section discusses what a wheel and axle system is for an introduction to the examples. The rest of the pages talk about a wheel barrow and a rolling pin and how they work. After the examples there is a section called new words for vocabulary to help with any tough words the students might not know.

For those students who still are having trouble with the concept of gravity before this lesson, the book *Why Can't I Jump Very High? A Book about Gravity* by Kamal Prasad could help. Simple explanations done with pictures in a book can sometimes be a strong help to students who are struggling with a concept.

Douglas, Lloyd. What is a Wheel and Axle?. CT: Welcome Books, 2002.

Prasad, Kamal. Why Can't I Jump Very High? A Book about Gravity. 1st. Graton, CA: Science Square Publishing, 2004.

Transforming content into teaching – how do theories inform practice?

The teaching of this lesson proved to be interesting from both the class of 1st graders and 21-year-old audiences. This lesson was one that had numerous concepts and was very deep in that aspect. Things we see every day were included, such as gravity, wheels, and wheel and axle systems were involved. In the elementary classroom, the moment that really stuck out to me was when I was trying to get the point across that it does not matter how big the wheels are to get it to go straight, as long as they are the big size. They did not fall for my trick of asking if it was the yellow small wheels making it turn, but they did seem to be adamant about saying the smaller wheels make it go faster. This is where their ZPDs came into play because with a little push from me, many of them (I think?) were able to understand that the wheels have to be the same size. Without that little bit of help from me they would have continued to think the smaller the wheels, the faster the system.

After teaching this, I feel as though it would be more fun and would affect the students understanding more if I was a more experienced teacher and had a good classroom management system down. With a lively bunch such as those in my class, it was difficult to get some understanding while all they could focus on was the fun they had and the axles breaking.

Science Lesson on Measurement – kindergarten

Elizabeth Jazinski

1. **Ideas and Practices**
   a. **Objectives:**
      i. Math - Objective 2.01: Compare attributes of two objects using appropriate vocabulary (length)
      ii. Science – Objective 4.02: Determine the usefulness of tools to help people
      iii. Science – Objective 4.03: Apply nonstandard units of measurement
   b. **This includes both knowledge and skill. The student will need to know that:**
      i. Predicting is making an educated guess and using what you already know to answer the question.
      ii. Comparing objects in length can be longer, shorter or the same
   c. **The student will need to be able to:**
      i. The student will predict which team member has the longest arm and the longest let.
      ii. The student will measure the length of arms and legs with tape paper (nonstandard unit of measurement)
      iii. The student will compare the length of the two lengths.
      iv. The student will discuss why it is important to use a common starting point when making comparisons
2. **Explanation of scientific ideas**
   a. **Comparing objects**
      i. Comparing and contrasting is a very difficult concept. But we can look at it as the way some things are the same and different. For example, we know that some people are 4 feet tall and others are 4.5 feet tall. We can compare them as similar if they are both girls but contrast them if we are grouping by height. We can compare two soccer balls; one is red and the other is blue. When we look at the attributes or characteristics of objects we can categorize them into different groups. Depending on the groups objects could belong to more than one group.
   b. **Predicting outcomes**
      i. Students will gain experience in this lesson with making educated guesses, the first step in learning to make predictions. A prediction relies on prior experiences, knowledge, or theories to have some degree of certainty that we will predict correctly. Students will be able to make the connection with the length of their legs and their height; predicting that if Jonny is taller than Suzy, Jonny probably has

longer legs. We can explain this to students by saying that many people and scientists often make predictions. A weather man makes predictions about the upcoming weather. Sometimes they are right and sometimes they are wrong.

3. **Description of children's commonly held**

   Due to the complexity and abstract nature of the concept of measurement we can look to Piaget's conservation tasks to help us explain why and how children think about things such as length. Piaget's conservation task explores children's ways of looking at things such as numbers, volume, length, or matter. How children recognize that certain characteristics or properties stay the same when an object simply looks different. Thus, when I asked my kindergarten students on the first day of our lesson why we measure things? They responded with, "Because they're big." When I showed them pictures of different objects of people and asked them about the characteristics of these things; for example, when given a picture of a young (8 year old) girl and a watermelon that she was holding, I asked, "Do you think that the watermelon is heavier or the girl is heavier?" The majority of the students said that the watermelon was heavier because it's big. When I asked them what types of things we measure they responded, "The table, the whiteboard, the bookshelf." But when I asked them why we might measure those things they simply said, "I don't know, because we should." It surprised me that when I asked what tools we measure with they said ruler, our shoes, a book. After the lesson, as we wrapped up our final assessment discussion I asked some of these same questions again with responses such as, "We can measure the length of our arms and legs to see if we are tall enough to reach the cabinet or sit in the front seat." They were also able to successful look at a variety of pictures and answer questions such as which object is taller, shorter, heavier, bigger.

4. **Activities and resources useful to teach ideas and practices**
   a. **Activity:**
      i. Teacher will read the class a quality piece of literature to get them thinking about comparing objects. The teacher will ask the students questions about the book; for example, what types of things do we measure? Why do we measure things? What tools could we use to measure things?
      ii. Teacher will inform the students that today they will be measuring the lengths of their arms and legs with a partner. We will be using paper tape. Why might we need to know the length of our arms and legs? If we are buying clothes, would you need to know the length of your arms and legs? Why?
      iii. Materials that will be needed will be distributed before the students return to their desks: worksheet, paper rolls, glue sticks, scissors, pencil, poster paper.
      iv. Students will return to their desks and work through the steps one by one with the teacher.

v. Looking at your worksheet (side that shows a boy in a wheelchair) put your name at the top where it indicates name.
vi. The first question asks you to look at your partners arm and without placing them side by side just observe and take a guess as to whose arm is longer.
vii. Write that person's name in the blank that will then read: I think (Suzy) has the longest arm.
viii. Now the first person is going to take the pink paper roll and measure their partners arm from shoulder to wrist and cut it at the wrist.
ix. Put the person's name on it (the person whose arm it is not the person who measured it)
x. The teacher will demonstrate if necessary
xi. Then the second partner will take the yellow paper roll and do the same procedure measuring the length of their partners arm from shoulder to wrist.
xii. Place the person's name on the strip of paper.
xiii. The student will then place the two pieces of paper side by side both starting at the red line of the poster paper and see whose is longer.
xiv. They will then record this information on the worksheet so the second question will read: I found that (Jonny) has the longest arm.
xv. The students will repeat this entire process for the length of their legs.
xvi. The teacher will demonstrate when necessary and circulate to assess how the student is comparing and arranging.
xvii. Assessment will be done through check list and an informal discussion asking students; why do we measure things? What can we measure? What can we use to measure objects? How did you use the red starting line on the graph? Why? What information can you tell us about the graph?

b. Resource:

i. Murphy, Stuart J. (1997) *Just enough carrots*. New York: Harper Collins.
   1. This resource deals more with measuring amounts, but is a great book for introducing measurement of objects if you are going to first talk about amounts and then progress to length

ii. Murphy, Stuart J. (1997) *Perfect Parade of Bugs*. New York: Harper Collins.
   1. This book is a great interactive book that gets the students involved in answering questions on each page. It compares lengths of bugs and asks students different levels of questions which is great for differentiation. Some of the questions include, which bug is longer? How many sections longer is this bug? Both accompanied by pictures.

5. Transforming content into teaching:

In the minds of 5 year olds, perfection is symbolized by toys and crayons. So it took me a while to sit down and analyze my teaching. I was prepared for confusion and complexity, but not in the way I experienced it. The thought of introducing new processes or scientific ideas to 5 year olds is very intimidating. It was not until I looked more closely at Piaget's Conservation Tasks that I realized these students really learned something from the above activity. I allowed them to come to their own conclusions about measurement. When we first started the lesson, they were unsure of what measurement was or why we measure things. So instead of giving them the answers and then proceeding with the activity, I simply said well let's do an activity and see what we find out about measurement.

It was a combination of events that led most of my children to that "aa hah" moment. If you study the conservation task of length, you find that it is very hard for young children to conceptualize the fact that if a piece of play-do is rolled out into a linear object that is 6 inches long laying vertically and you have the same exact length of play-do except it is laying horizontally instead of vertically, those two objects are the same length. Most children will tend to say that the one lying horizontal is longer.

When I was at recess with my student a week before I taught my lesson on measurement and length I was writing with chalk on the pavement and one of my students asked me to look at the lines he was drawing. They started at different places but it was evident that one was significantly longer than the other. When I asked him which he thought was longer he pointed to the shorter one. I asked him why he thought this and he said, "Because it goes further into the street." Their young minds do not have the tools to process the concepts of longer and shorter without similar starting points. So as the students proceeded with our activity on measurement of length they began to come to similar conclusions about using tools they knew to make predictions. For example, the students began to see that if Johnny was taller than Suzy, than Johnny probably had longer legs than Suzy. Allowing students to figure these things out on their own helps them fine tune their processing skills and thought process. If I had told them what measurement was, it would have been more difficult from them to analyze the process.

Allowing them to come to their own conclusions lets them figure out how something works and why. This process of teaching allows them to observe or create experiences for themselves, make connections with patterns in their experiences and then those experiences and patterns allow students to explain why things are the way they are. Through all of this they are inquiring and asking thoughtful questions about processes and properties and the students are then able to apply these explanations to other situations. When you challenger your students to come to conclusions on their own it forces them to think differently. You can foster their mistakes and value their answers in a positive way which will encourage them to explore new ways of thinking. Challenging your students to think in a new way will help them think more abstractly rather than concretely as kindergarteners do.

MEASUREMENT: "How Do We Measure An Object Without Using A Ruler?"

Kimberly McCutcheon

1. *Ideas and Practices*

Grade K: Science Objective

4.03 Use nonstandard units of measure to describe and compare objects.

Grade K: Math Objectives

4.01 Collect and organize data as a group activity.

4.02 Display and describe data with concrete and pictorial graphs as a group activity

Students would need to know that:
- Nonstandard units can be used to measure objects.
- Graphs are used to display and describe data.
- If something is measured and has more nonstandard units, then it is longer; if something is measured and has less nonstandard units, then it is shorter.

Students would need to be able to:
- Use a pencil to trace and cut out their tracing with scissors.
- Use fine motor skills to handle small objects.
- Count up to 20.
- Determine where they would place their marker on the graph based on the measurements that they conducted.
- Compare pictorial bar graphs

2. *Explanation of Scientific Ideas*

Nonstandard units are ways to find out how long something is. They have the same size, but are not usually used to measure length because they are not as reliable as standard units such as inches and centimeters. Nonstandard units can be anything from M&Ms to unifix cubes and paperclips to unsharpened pencils.

3. *Description of Children's Commonly Held Ideas*

After interviewing several kindergarteners on their beliefs about measurement, I discovered that many of them held the same misunderstandings. First, they believe that one can only measure the length of something with a ruler. This is clearly wrong, because we can use nonstandard units (paperclips, M&Ms, unifix cubes, etc.) to measure something. They believe that it is "silly to use objects, like markers, to measure something." Next, they believe that when one explains how long something is to someone else, they should hold their hands apart (the distance that the object is) and say, "it's about this wide." At this point, they have little knowledge that using precise numbers is a more accurate way to provide a description of the length of an object. They also believe that when comparing the length of two objects, depending on what you use to measure them, one object can be longer than another one time, and shorter than the other object another time. Once an object is measured, its size does not change unless the object is altered. For example, an unsharpened pencil will always be longer than a new crayon, no matter what is used as the measuring tool. The young students believe that the measuring tool determines the length of the object, rather than the object itself. Next, these students believe that one cannot use small objects to measure something; "the measurement tool must be as long as a pencil." Clearly, we use a range of measuring lengths, from large tools, such as kilometers, to small tools, such as nanometers. Young children do not have the concept of extremely small objects and therefore cannot understand that we can use very small tools to measure objects. They also believe that length is the only thing you can measure. Kindergarteners begin measuring length and do not move to measuring other distances, such as width and height, until they are older. This is the only knowledge they have at this point. Finally, the students told me that measurement is only used to compare the length of two objects. They typically compare objects to determine which is longer and which is shorter, to develop this concept. They have not yet made the connection that one can measure a single object simply to find out its length without comparing it to another. The kindergarteners seemed to know a lot about the concept of measurement, but they had several misconceptions.

(Ideas and misconceptions taken from interviews of kindergarten students.)

Research has been conducted to determine common misconceptions that young children have about measurement. First, it was established that children believe that measurement is only linear. They only use straight lines to measure objects, at this point in their life, and therefore it is all they know. It is also believed that children who have used measuring devices at home already know how to measure. Many children feel inadequate when they discover that other children have used measuring tools before, at home. They feel as if these students will be more advanced and will know how to measure objects "better" than they can. Teachers also fall into this misconception as well. Children may have incorrectly used the tools, or may not have a full understanding of why and how we measure objects. Next, it was determined that children believe you can only measure to the smallest unit shown on a measuring device. For example, if the student is using a ruler to measure something, they will have the idea that they smallest unit they can use is a millimeter because that is the smallest unit that they see at that current time. However, it is clear that people can use a variety of very small measuring devices regardless of the numbers on their measuring tool. Next, students believe that some objects cannot be measurement because of their size. At this age, students have very limited use of measuring objects. They have typically measured a variety of objects in their classroom, but rarely measure objects smaller than a paperclip or eraser. They simply believe that some objects are too small to measure because they have not had experience doing so. Finally, young children believe that the five senses are infallible. For example, they believe that if they see or touch a specific object while measuring it, then their measurement is correct. Whatever they hear, touch, see, taste, or smell is foolproof, dependable, and flawless. However, our senses can be deceiving and oftentimes are fallible. Thus, it can be determined, that young children, especially kindergarteners, have a variety of misconceptions about the use and purpose of measurement.

4. *Activities and Resources Useful to Teach Ideas and Practices*

Activity

Materials:

- Construction Paper for students to cut out their hand shape
- Pencils
- Scissors
- Glue Sticks
- M&Ms (2 large bags)
- Small Paperclips (~300)
- "How Many M&Ms Tall Are Our Hands" Blank Graph
- "How Many Paperclips Tall Are Our Hands" Blank Graph
- 2 hand markers per student
- My sample hand with M&Ms measuring the length (previously glued on)
- My sample hand with Paperclips measuring the length (previously glued on)

Sequence of Lesson:

- The teacher introduces the lesson by reading *Twelve Snails to One Lizard* by Susan Hightower.
- The teacher asks, "How do we measure something?"
- The teacher writes the children's responses on the board.
- "In the story, Milo needed to cut his branch a specific length, but he could not find ruler to use at first. What did he use to measure his branch?"
- The students answer "snails and lizards."

- “That’s right. He used snails and lizards to measure his branch. We can use other objects to measure things also. These are called nonstandard units.”
- “I traced my hand on a piece of paper and measured how long it was by using two different objects. First, I used M&Ms! I lined the M&Ms up, on the cut out hand, from the bottom of my wrist to the top of my middle finger. Then, I counted how many M&Ms fits on my hand. 1-2-3-4-5-6-7-8-9-10-11-12-13. My hand is 13 M&Ms long. I also used paperclips to measure my hand. I did the same thing and lined the paperclips from the bottom of my wrist to the top of my middle finger. Let’s count how many paperclips long my hand is. 1-2-3-4-5-6. My hand is 6 paperclips long!”
- “Today, you are going measure your own hands and figure out how many M&Ms and how many paperclips long your hand is. First, we are all going to trace our hands onto a piece of construction paper. I will hand out the construction paper to each group.”
- The teacher hands out one piece of construction paper to each student.
- “Now, place your hand on the paper with your fingers spread wide open and take your pencil and trace around your hand.”
- The students trace their hands on the construction paper.
- “Great! I am going to pass out scissors and you will cut out the outline of your hand.”
- The teacher passes out scissors and each student cuts out the outline of their hand.
- “Alright! Next, I am going to pass out a bag of M&Ms to each students and a bag of paperclips to each group and you will use your own M&Ms to measure your own hand. After you measure your hand using the M&Ms, you will take turns and measure your hand using the paperclips. Be sure to remember how tall your hand is, so we can compare all our hand sizes!”
- The teacher passes out a small bag of M&Ms to each student and a bag of paperclips to each group of five students. The students spend about 5-10 minutes measuring the length of their hands.
- “Great job! Now, we will graph the results that you can up with. The first graph we will make is called ‘How Many M&Ms Tall Are Our Hands.’”
- “When I call your group, you will come up, choose a hand marker and glue it in the correct spot on the graph depending on how many M&Ms it took to make a line from your wrist to your fingertip.”
- The students come up in groups of five and glue a hand marker onto the correct spot on the bar graph that corresponds with how many M&Ms long their hand was.
- The teacher asks the students questions about the graph such as, “What was the length of the longest hand in the class?” “What was the length of the shortest hand in the class?” “Which length had the most hands under it?” Etc.
- The teacher repeats this process with the graph entitled “How Many Paperclips Tall Are Our Hands.”

- The teacher asks questions to compare the two graphs such as, "Did it take more M&Ms or Paperclips to measure the length of your hand?"
- The teacher asks questions to discuss the reliability of measuring with nonstandard units such as, "What do you think would have happened if we used rulers to measure our hands?" "Do you think we would have more accurate results?"
- The teacher then allows the students to eat them M&Ms.

(Lesson adapted from Hollie Humphreys)
http://www.learnnc.org/lp/pages/2958?syle=print

This activity is useful and educational in teaching students about nonstandard units of measure because first, it allows them to individually measure something. They are able to actually touch the nonstandard units and use them to measure the length of something. They are also comparing their results with one another. At first, students may think they when they measure with M&Ms or paperclips there will only be one *right* answer. Through this activity, they are able to understand that even though the measuring unit is nonstandard, it can still accurately determine the length of an object in relation to another object. Finally, they will be able to understand that a bar graph is an accurate way to compare the results in an activity because they will be able to visually see the results rather than simply discussing them. In a follow up activity, they would be able to use the results found in this activity to determine that standard units of measure are considerably more accurate than nonstandard units of measure.

Resources

- An appropriate resource to use within this lesson is a book entitled, *Twelve Snails to One Lizard* by Susan Hightower. (Book Overview: Milo the Beaver needs to cut a branch exactly 36 inches long to bridge a gap in his dam. Bubba Frog suggests different ways of measuring it--line up 36 healthy snails, feelers to tails, or 3 iguana lizards, nose to tail, or Betty Jane Boa all by herself. But the snails are too slow lining up, the lizards are too frisky, and it turns out that Bubba has a yardstick at home.) This book discusses using nonstandard units of measure to measure a branch. The character used snails and lizards to measure, but ends up using a yardstick because it becomes too difficult to use the nonstandard units. The book shows students that it is sometimes easier to use nonstandard units, however it is more precise to use standard measurements.
- Another useful resource to use within this lesson is a book entitled, *Super Sand Castle Saturday* by Stuart J. Murphy. (Book Overview: Three friends compete to see who can build the tallest sand castle, the deepest moat and the longest wall. They run into trouble when they start to measure the results, because each contestant uses a different nonstandard unit of measurement. Sarah's tower is three shovels tall; Juan's is only two shovels tall, but Sarah's shovel is much smaller than Juan's Larry gives them sound advice when he points out that, "Spoons and shovels and people's feet can all

be different sizes, but an inch is always in inch.") This book also discuses nonstandard units and relates them to standard units. It would be useful in a follow-up activity comparing nonstandard units to standard units and determining which one is more accurate.

(Book descriptions quoted from)
http://www.teachnet-lab.org/miami/2004/concepcion/twelve_snails.htm
http://www.teachnet-lab.org/miami/2004/concepcion/super_sand_castle.htm

These resources are useful in helping the students learn the concept of nonstandard units of measure because they introduce students to the idea of nonstandard units. Both of the books show an example of someone using an object, or objects, to measure the height or length of something else. After being read this book, the students will understand that it is appropriate to use other objects as measurement tools. It serves as a precursor to the ideas they will learn and understand in the activity that follows the read aloud.

5. *Transforming Content Into Teaching – How Do Theories Inform Practice?*

Before presenting my activity to the class, it was clear to me that this activity, designed for kindergarteners, would not be challenging for college students. I thought it was significantly under their zone of proximal development; however, my idea somewhat changed after the event.

First, the college students had trouble telling me which column in the graphs contained the least amount of hand markers. I thought my questions regarding the graphs would be mundane and boring for my peers, but it was apparently more challenging for them than I thought. After asking them this question, about half of the students replied that the column with one hand in it contained the least amount of markers. However, there was one column that was completely empty. The more experience that someone has with something, the more confident they become. The students assumed the question was easy and under their ZPD, but in fact, they had some trouble with this concept. I think, as a teacher, I made the students realize the importance of looking at the big picture, rather than zoning in on one small aspect of a graph (or other learning device).

One other area that the students had trouble with was explaining, in words, the meaning of a nonstandard tool. I asked the students what they learned during the activity, at the end of the lesson. One student replied that she learned what a nonstandard unit was. However, when I asked her to explain to me what it was, she could not. I think she understood the concept, but had trouble putting this idea into words. This is often something that people struggle with and I feel that I could have explained, before the activity, what a nonstandard unit was, in more detail. This part of the lesson seemed to hit directly in the students ZPD. They understood the idea, but had trouble explaining it, making it somewhat of a reach for them in terms of difficulty.

Finally, as a teacher, I feel I could have been more specific with my instructions. I used a pre-cut hand with M&Ms and paperclips glued on as an example for the students. I did not, at this time, explain that during the activity, they would not be gluing the nonstandard units on their hand. Many of them thought they needed to cut out two hands and copy exactly what I did. I feel I could have made this clearer during the instructions.

Overall, I think the lesson went well. I feel as if the college students actually learned a few ideas from my lesson that was originally aimed at kindergarteners. Both the students and I went into the lesson believing that it would be easy for them to complete; however I felt that they encountered a few challenges during the activity. Although the lesson was not originally aimed to be in their zone of proximal development, a few of the ideas actually ended up being appropriate for their learning zone. They needed help with a few notions, yet were able to complete most of the activity independently.

Science Lesson on Bones and Muscles – 3rd grade

Kelly McManus

Ideas and Practices:

1. NCSCOS Objectives – 3rd grade
   4.01 Identify the skeleton as a system of the human body.
   4.02 Describe several functions of bones:
      - Support
      - Locomotion
      - Protection
2. This includes both knowledge and skill. Students would need to know that:
   1. Inside human bodies there are bones.
   2. These bones have the job of either protecting or supporting an area of our body.
   3. Need to be able to add numbers for measurement.

   Students would need to be able to:
   1. Add numbers in decimals.
   2. Be able to point to certain areas of their body
   3. Know the difference between supports and protect.

Explanations of scientific ideas:

Skeleton: Every human has a skeleton. Our skeleton is made up of bones, and tissue that protects and supports others parts of our body. When you were a baby, you had tiny fingers, tiny hands, and tiny bones! As you grew older, everything grew bigger, even your skeleton. At birth you had 300 bones, but some of these bones fuse, or blend, together. So when you're an adult you have only 206 bones. At the age of 25, your skeleton is done growing and your bones will be as big as they will ever be. All of your bones are what make up your skeleton that is very strong and light.

Bones: From our head to our toes, our bones provide support for our bodies and help form our shape. The skull is a bone and it helps protect our brain. The skull also forms the shape of our face. Bones are in our body to help us move, support, and protect all the other organs of our body. Not all bones are the same size though. They come in different shapes but they are not that heavy. They are very strong and hard. Our bones are alive and they are growing and changing all the time like other parts of our body. If we didn't have bones in our body then we would be walking around like jello (Kids Health)!

Description of children's commonly held:

When I interviewed my third graders about what they thought bones were I was not expecting them to have many abstract thoughts. I made sure that I asked a variety of students so I could get a full understanding of what third graders believed about the make up of their body. I asked my first student what they thought a skeleton was. They responded, "It's the thing inside you when you take away all your skin." I then showed the student a picture of a skeleton and a picture of a human with just the tissue showing, not the bones. I asked which one was a picture of just the skeleton and the student picked the correct picture. Another student responded to the question of what a skeleton is by saying "something inside you." This student also picked the correct picture. I was glad to know that both students grasped the idea that your skeleton is inside your body.

I also asked two other students why we have bones. One responded with saying, "to hold us together." The other responded, "To be able to move, I don't know." I thought these were very good answers from a third grade class. I also asked students if they thought other things on earth had skeletons. She responded, "Dogs, and cats do I think." These students were successful in knowing where a skeleton is and knowing why we have bones. I was impressed and glad to hear such good answers. The first students I interviewed didn't say anything about why we have a skeleton and what it does for us. They described where it was and what it looks like. The other students who I asked why we have bones both said because they help us move and hold us together. After each student I interviewed they all immediately started telling me a story about them breaking a bone or someone they knew that had broken a bone. Their answers are pretty accurate but if I asked more questions such as "what is the difference between muscles and bones" then I'm pretty sure I would get some conceptions that were inaccurate.

Activities and resources useful to teach ideas and practices:

Procedures:

1. Open up the class by reviewing any thing you did before dealing with bones and muscles. After that go over the different parts of a skeleton for a review.
2. Tell the students that today they will be players in the "Bones-and-Muscles-Know-It-All Olympics." Divide the class into teams for a round of *Name That Bone*. I chose Goblins and Trolls.
3. Give each group an unlabeled skeleton to use as a reference. Have two students at a time from each team come up and "pick a bone" from a hat or bowl and try to answer the questions.
4. Possible questions include:
    a. What is the largest bone in the body? (thigh bone or femur)

b. Where are the smallest bones in the body found? (inside the ear)
c. What is the soft bone called that is found in the ears and nose? (cartilage)
d. Name a bone in the lower arm. (ulna or radius)
e. Name a curved bone. (rib, jaw)
f. What are the little bones stacked up along the spinal cord called? (vertebrae)
g. What bone protects the brain? (skull)
h. What is the mineral called that keeps bones hard? (calcium)
i. Name a hinge joint in the body. (elbow, knee, finger)
j. Name a ball-and-socket joint in the body. (shoulder, hip)
k. What holds bones together at the joints? (ligaments)
l. Name a food that is rich in calcium. (Milk, cheese, spinach, etc.)

5. Score the round and name a winning team.
6. Tell the students that the second round in the Olympics is called Skull Busters. These are tough questions that might need pencil and paper to figure out. Have all students work on Skull Buster questions and then add up the number of correct answers from each team to keep score.
7. Possible questions include:
    a. A finger has three bones. A thumb has 2 bones. How many bones are in four fingers and 1 thumb? (14)
    b. If the human body has 12 pairs of ribs, how many ribs do we have? (24)
    c. There are 32 bones in an arm and a hand. How many bones are in 2 arms and 2 hands? (64)
    d. If the femur is averaging 19.9 inches and the shinbone is averaging 16.9 inches, then how much longer is the femur than the shinbone? (3inches)
8. Tell the students that the final round of the Bones-and-Muscles-Know-It-All Olympics will require one member of each team to come to the front. Tell the contestants that they will be given the name of a bone or muscle. The first one to point to the bone or muscle being named will score.
9. Possible bones and muscles to identify are: skull, shin bone, radius, vertebrae, ribs, thighbone, bicep, triceps, kneecap, Achilles tendon. Have the student's help you tally the final score in the Olympics and declare a winning team.
10. Remind the students that bone, muscles, ligaments and tendons help us move but that the command center must send the muscles messages. Tell the student that next lesson they will be learning about the command center between their ears--the thinking brain.

Transforming content into teaching:

I did not get to teach this lesson to my third grade class but I got the privilege to teach it to college students. I was excited to do "Bones and Muscles Know It All Olympics" and it looked like the college students enjoyed it. Believe it or not, elementary students are competitive and love to play games when learning. This is why I thought of this activity would be good because it was a challenge for them to learn. Also, I was treating the whole class as one community. Everyone was involved and doing the same things. They were all able to relate to what was happening.

They were divided into two groups so that allowed them to come to conclusions together. That goal did not get accomplished when I taught this lesson because everyone was shouting out their own answers and not discussing them as a team. Next time I teach this lesson I will remember that. I made sure to review at the beginning of class some important bones and facts about the body to get their prior knowledge thinking. This helped during round one of the game because some of the review questions were in that round.

I was really happy with how round two went because it involved another subject area which was math. We were learning about the different lengths of bones and adding and subtracting the measurements. It's almost like I was knocking two birds out with one stone with teaching science but involving math. I believe this was the favorite round of the college students because everyone knew how to add and subtract so they were motivated to try and figure out the answer. I believe that it's really important to have integration in the classroom. Students benefit from it so much because they can relate subjects to one another. Plus, its great practice for them to do some writing in science or to do some math in social studies. Knowledge is integration plus the experience you get when learning it. Knowledge is on a context level, a social level, and an experience level. As a teacher I want to make sure my students have an enduring understanding of what is being taught so they can carry it with them to the next grade and through life.

Incorporating math was an idea I used to think about how I wanted to teach this lesson. I didn't want to cover just science and facts the whole time. It's always good to try to integrate different things into a lesson to show students how everything is related. Treating the class as a community was another idea I had for my teaching. I did that my making a game out of the lesson and dividing them up into two teams. They got to work together as one. My ideas for my teaching are to provide knowledge through a context level, social level, and an experience level. I believe that I provided all three of these during my lesson.

"Bones, Muscles, and Joints: The Musculoskeletal System." Kids Health. The Nemours Foundation. ©1995-2008

http://kidshealth.org/parent/general/body_basics/bones_muscles_joints.html

Bones and Muscles. Google Search. http://www.cstone.net/~bcp/3/3NSci.htm

Teaching Wind Using Bubbles

Samantha Montgomery

1. Ideas and Practices:

In the second grade children are expected to know about weather focusing on the water cycle, wind, air pressure, and other devices used to measure different types of weather. This lesson is focused on wind, how it works, and how it affects other objects. The North Carolina Standard Course of Study objectives for this lesson are:

- Objective 2.01 Investigate and describe how moving air interacts with objects

This objective includes both knowledge and skill. Students need to know that:

- Air is something that cannot be seen
- Air can move
- Moving air affects objects

Students need to be able to:

- Make observations about air
- Draw conclusions about the relationship between moving air and objects
- Connect their observations to real life

2. Explanation of scientific ideas and practices:

Wind is an important part of weather and it is important for students to know how it works. Wind is moving air, and observing how moving air affects objects is what the students will be doing. The North Carolina Science Skit describes wind as moving air that can blow at different speeds, including calm, light breeze, moderate breeze, and strong breeze. When the wind blows, we can tell how strong it is by watching objects affected by it. We can see trees, kites, and flags move outside. In the lesson, we will watch bubbles move, and we will be able to tell which way the air is blowing and how hard by seeing which direction and how fast the bubbles are moving.

3. Description of children's commonly held:

My students were all in different places when the topic of wind arose. We had been working with weather in the science lessons prior, and the students knew rain came from the sky but most lacked the knowledge about the water cycle. The same idea was present with the concept of wind. Students knew they couldn't see wind and they knew it was present when they saw trees move, but that was the extent of their knowledge. Some students did not know the answers to what makes the trees move outside or how to define wind.

4. Activities and resources useful to teach ideas and practices:

The North Carolina science kit had a very unique way to teach children the concept of wind. They have the teacher start by holding up bubble solution and asking the students what it is; most students will have seen a bubble container before and based on their prior knowledge, will be able to answer the question. The teacher will then blow a bubble and ask the students questions about it.

- What is a bubble?
    - A thin sphere of liquid that holds air or gas
- What is on the inside of a bubble? Can you see it?
- What's on the outside of the bubble? Can you see it?
- What moves the bubble around?

The teacher then explains that, even though students cannot see the air, they can use bubbles to see where the air is moving. The class will then go outside and play and observe bubbles. As they are working with the bubbles, the teacher goes around asking questions to the pairs.

- How can you use bubbles to show if air moves around corners?
- How can you use bubbles to show where the air moves fastest?
- How can you use bubbles to show where the air moves slowest?
- How can you use bubbles to show how air moves in a doorway?

The teacher lets the students explore for about ten to fifteen minutes before asking them to wrap up and head back inside. Once inside, the teacher allows the students to clean up and then asks them to come to the rug.

- What do bubbles have to do with air?
- What can bubbles tell you about the air?

The only thing I added to this lesson was reading a short story about wind from a weather book at the beginning of the lesson.

5. Transforming content into teaching—how do theories inform practice?

Transforming content into teaching is a huge aspect of effective education. I have yet to teach this lesson in my classroom so the ideas and concepts I talk about are issues I am anticipating. One issue I believe I will have are building on the student's background knowledge and breaking any wrong schemas they may have.

From my interviews, I know that most of the students have an idea about wind, but instead of building on previous schemas, I will be creating a new one. I will be introducing wind as a concept and I want students to start with an almost blank slate. Prior knowledge showed that the students know what makes the trees move, but they don't know exactly what wind is. They don't know how wind affects objects, such as trees, just that it does have an effect on them.

I will be teaching another lesson on wind after the introductory one so it is important that I build a strong foundation. I really want to make sure the students understand the concepts I am teaching so when I teach a more complex lesson, they will have a basis of knowledge to refer to. I don't want to teach about anemometers and wind measurement if they are still confused on the meaning of wind. It is important to develop their schemas because many of their future lessons will deal with the same concept.

Comparing Apples Activity

Darani Nguyen

Ideas and Practices:

Grade K:
3.02 Develop and use a vocabulary associated with the properties of materials:

- Color.
- Size.
- Shape.
- Texture.

3.03 Describe how objects look, feel, smell, taste, and sound using their own senses.

This includes both knowledge and skill. Students would need to know that:

1. Objects have characteristics that can be observed
2. Characteristics can be used to compare objects

Students would need to be able to:

3. Make observations of materials and identify characteristics.
4. Use their senses to describe objects.
5. Be able to connect their observations to the characteristics.

Explanation of scientific ideas and practices:

Students should be actively involved in exploring the world around them. They should investigate in a fun and exciting manner, and constantly explore things around them. To make exploring more pertinent, students should tell others what they see in their explorations as well as what they think and wonder about. Students should be allowed to discuss what they observe and to compare what they observe with others. To observe characteristics, students look at someone or something and look at the qualities of it. Those qualities are the characteristics of that person or thing. For example, when looking at Mr. Nguyen, some of his characteristics are black hair and glasses. To compare based on characteristics, students must look at two related things, and using their characteristics, tell how the two are alike and similar. For example, using an apple and orange, students would observe and see that both objects are fruit, but one is orange and one is red in color. Students in Kindergarten should be making observations and experimenting. This can build a foundation for students to use tools which give more information than what comes from simply observing. Students should be able to describe things well so that they can compare their observations with others. It's also important to note that not everyone's observations will be the same.

Description of children's commonly held:
For my lesson, I have students making predictions about the flavor of some of the apples they will be tasting. When I did so in class, I noticed that some students wanted to keep their predictions regardless of their thinking. This is consistent with what we know about students' commonly held ideas. When they predict, they form opinions that are resistant to change. For the golden delicious apple, I had the students predict what it would taste like. It was the last of three apples and the other two were either sweet (Red Delicious) or sour (Granny Smith) and with a name like Golden Delicious, I thought everyone would guess sweet. Of course, some students predicted sour regardless and even when they tasted the Golden Delicious apples, students that had predicted sour were convinced it tasted sour.

Activities and resources useful to teach ideas and practices:

The theme of the day's lessons will be "apples" and students will be working with apples throughout the day. For my science lesson, I have used resources lent to me by my cooperating teacher to come up with this activity. In an activities book from *The Mailbox* magazine entitled: Quick & Easy Science Fun: Over 100 Simple Experiments, Activities, & Demonstrations, I discovered my activity in the Life Science section. The original activity was called "Apple I.D." but I made slight moderations to it (i.e. my worksheet). The original description from the activities is as follows:

Apples, apples, apples! Apple varieties are great for practicing classification and sorting skills. Choose three or four distinctively different apple types, gather several of each type. Locate a picture of each type of apple by checking grocery store advertisements or seed catalogs (or draw your own illustrations). Glue each apple picture onto a card as shown. Mix all the apples together. Have youngsters work together to classify the apples, using the picture cards as a reference. Discuss the similarities and differences in the types of apples. Then offer youngsters a sample of each type of apple and discuss the similarities and differences in taste and texture. So many apples, so much learning!

This activity was great at helping students make observations and comparisons. With it, students make observations about the variety of apples I present to them. Then, based on the characteristics we go over and discuss, students will compare the apples based on their characteristics.

My additional resource that is to be used with the activity is a piece of children's literature entitled, "Up, Up, Up! It's Apple Picking Time" by Jody Fickes Shapiro. This is a great text to use with this activity because it talks about all the types of apples and has pictures for each kind. I would use this text before my activity, and using it, I would discuss characteristics (or "attributes" as my teacher had me introduce the vocabulary to the students, rather than the term "characteristics.") in advance so that students would be able to grasp the concept of it and know the definition beforehand. This would help my activity out greatly because having to explain characteristics as thoroughly as I did during my activity caused a time restraint. Using this additional resource, I would expose children to characteristics ahead of time, and this could help the students pick up the activity a lot faster.

Transforming content into teaching – how do theories inform practice?
It is challenging to locate any theoretical ideas that are relevant to this activity since it was for Kindergarten and the concepts taught in that low of a grade level are difficult to pair with any theoretical ideas. While teaching, I did notice that students picked up quickly that the characteristics could be used to describe the apples. Initially, I guessed that students would have a hard time connecting that characteristics could be used in descriptions rather than just being a part of it object. Basically, I was worried about their conceptual acceptance of comparing/classifying based on observable characteristics. Rather than that, there were no theoretical/conceptual ideas that I encountered that seemed relevant to such an elementary activity. I don't understand the last sentence.

Jeopardy Erosion/Landforms Activity

Brie Owen

1. Ideas and Practices:

NCSCOS Objectives:

2.01 Identify and analyze forces that cause change in landforms overtime including: water and ice, gravity, and wind.

2.03 Discuss and consider the wearing away and movement of rock and soil in erosion and its importance in forming: canyons, valleys, meanders, and tributaries.

2.04 Describe the deposition of eroded material and its importance in establishing landforms including: deltas and floodplains.

2.05 Discuss how the flow of water and the slope and the land affect erosion.

Practices:

The students will be able to identify and explain what weathering is, how it happens, and what happens to the rocks and soil that it breaks down.

The students will be able to explain and define various vocabulary words:

Erosion, landform, canyon, delta, plateau, sediments, basin, channel, meander, slope, flood, dam, elevation, valley, plain, prairie, river, strait, peninsula, mesa, lake, isthmus, island, gulf, and volcano.

2. Explanation of scientific ideas:

Weathering is the wearing away of Earth's surface either by water, temperature, or air. Earth's materials, such as rocks and soil, are broken down and then carried away from their existing position, which is called erosion. Erosion can happen from wind, water, ice and gravity. Eventually the weathered materials that are moved around by erosion are deposited or put down in other land areas. When deposited, Earth's materials begin to build up on top of one another and they naturally create new land masses which are also known as landforms. There are many different types of landforms such as hills, mountains, plateaus, and plains which are all created naturally from the weathering and erosion of materials on Earth's surface.

An example of weathering and erosion by water is the sand and the ocean at the beach. The water waves pull the sand away from the beach and carry the sand into the ocean to deposit it elsewhere. The water weathered the sand on the beach and then the water eroded the sand out onto the ocean floor.

3. Description of children's commonly held ideas (conceptual change):

Since this was a review activity you said I did not have to worry about interviewing the students because they had already learned the science ideas.

4. Activities and resources useful to teach ideas and practices:

Activity: Jeopardy game using a tri-fold poster to create different categories or types of questions. My four categories were the types of questions: identify, fill-in, define, and mystery. Each category had 5 questions ranging from $100-$500.

Resource: Cracking up: A story about erosion (science works) by Jacqui Bailey.

5. Transforming content into teaching—how do theories inform practice?

Immediately following my lesson I reflected and thought it went really well. I was nervous the questions would be either too hard or too easy, but there was a good mix which catered to each level of learners. The first thing I thought that I would change if I had the opportunity to do it over again was to work more closely with my CT when compiling the questions and answers because I thought it would enable me to create questions and answers that were worded according to how my teacher taught them. As I continued to think about this I realized that it was actually better for my students that my questions were worded differently because when they answered correctly it meant they truly understood the concept and didn't just memorize a word and its definition. Their prior knowledge was vital for this activity and my students proved that they had the knowledge it took to review what they had spent a week learning about.

Since I had the students working in teams their sense of classroom community had to be acknowledged and I felt they worked really well together. For the most part the gave students gave each other the chance to explain their answers they thought was correct and really worked as a team to come to the answer they saw best fit. There were, of course, one of two students who were dominating the questions and a few students who were quiet and didn't contribute as much as the others; this is the problem with group work. While it can be helpful for students to collaborate I know that I need to be mindful of ensuring that all students have the opportunity to practice their knowledge and be challenged at their own level.

Another thing I noticed during the lesson was that some students couldn't put their answer into words; they had trouble trying to explain what was in their head. I could see where they were coming from because this is something I often have trouble with, but I've come to realize that once you can explain something or put it into your own words you truly understand it so I gave them some time to gather their thoughts and then explain it to me in a way that made sense to themselves as well as myself and the rest of the class.

Lastly, the students really had trouble with understanding why they got a question wrong. If a team got an answer wrong the next team was able to answer, once the correct answer came out the teams who had gotten it wrong couldn't understand why their answer was any different. I found this hard to deal with because they would argue with me and it took a lot of explaining for them to comprehend the difference between their answer and the correct answer. I tried reading the question and then giving the correct answer and explaining why it was right, and then I took their answer and explained how it differed from the correct answer and why it was wrong. This strategy seemed to work well with them and they slowly began to understand they had to be careful when explaining their thoughts and knowledge on a topic or particular question.

Simple Circuits

Cullen Pitler

Ideas and Practices:

NCSCOS objectives –

- 3.05, Design and explain the parts of a light bulb
- 3.03, Design and test an electric circuit as a closed pathway including an energy source, energy conductor, and an energy receiver.

Science Process Skill Statements –

Students will be able to -

- build and compare simple circuits with a focus on how connections are made
- demonstrate evidence of the flow of electricity

Students will know –

- the essential components of an electric circuit and their functions

Explanation of scientific ideas:

In this lesson, students are learning about electricity and how it works. Electricity of the result of a property of a subatomic matter called charge. Charges in an atom are usually balanced meaning that they have an equal number of protons and electrons. When these are not equal, energy becomes available. In this activity the electric current is the D-cell/battery (these words are used interchangeably throughout the experiment even though scientifically speaking D-cells are not batteries, batteries must have two or more cells). The electricity receiver is the light bulb. Inside the d-cell, a chemical reaction is taking place because of the sharing of electrons. This exchange of electrons is happening through the wire that is connected to the battery. The movement of the electrons through the wire is what we know as the electrical current. When the light bulb is connected to the wire in the correct places the battery pushes electrons through the wire, and the light bulb captures it.

Electricity works when it is channeled into a pathway that connects the two terminals to a battery. This pathway is what scientists refer to as a circuit. The pathway must go from one terminal on the battery to the receiver and from the receiver back to the terminal of the source. When there is complete circuit electricity is able to flow through the components and the electrical receiver will operate (Malone, 2000).

Description of children's commonly held ideas:

In order to determine the children's commonly held ideas about electricity, I started the lesson with a KWL chart. This way I was able to discuss as a class the things they knew and the things they wanted to know at the start of the "experiment." It also served as good closure for the end of the unit for the students to be able to discuss what they learned.

Many of the students thought they would be able to light the bulb by taking one wire and touching it to the metal part of the light bulb. When doing this, it was their belief that if an electricity source and electricity receiver were connected by a wire, the electricity would be received and the bulb would light. Other students used two wires touching one end of each one to the battery and the other ends both to the metal part of the light bulb that is connected to the glass. In this conceptual framework, the students knew that all the elements in the circuit needed to be connected but did not understand the positive and negative charges that needed to be connected to the battery.

When trying these models and realizing they did not work, students test others methods using trial and error and eventually replace their previous conceptual model with another.

In addition to the ideas they had about the experiment, I also asked them to talk to me about what they knew about electricity. Some of the things they discussed included:

- There are different levels of power
- We use it for many things like lights, cars and appliances
- You can get electrocuted
- Benjamin Franklin discovered electricity
- And some small facts about conductors (what types of things were conductors)

When given the supplies, students are able to explore their own ideas and inquire about those ideas they do not fully understand. Every student enters the class with previously held ideas, in this case, about how electricity works. Through direct observation, they are able to understand the science behind the ideas.

Activities and resources helpful to teach ideas and practices:

1. Teacher starts the lesson by creating a KWL chart. This is a way for the teacher to get a good idea of the student's previous knowledge about electricity and how it works. It also allows the students to ask questions about electricity and share what they are interested in.
2. TW then introduce the D-cell to students. "This is a D-cell, most people call it a battery. It is an electricity source. Source means a place to go where something is available, or where something comes from." Ask the students what they think D-cells are used for.
3. TW then introduce the light bulb.

4. TW have students draw a detailed picture of the light bulb so they are able to observe all the different parts.
5. TW hand out all materials to groups of 2.
6. TW monitor all groups while they try to light the bulb. Once the students have figured out one way to light the bulb, challenge them to try to find another.
7. Once most groups have figured out one or more ways of lighting the bulb ask 3 groups to come to the board and draw their circuit.
8. Have the students present what they did and talk about the differences between the drawings.
9. Review the vocabulary that was used such as: D-cell, electric source, electricity receiver, circuit, filament, component

Additional Resource:

United Streaming Video:
http://player.discoveryeducation.com/index.cfm?guidAssetId=2A8797BB-21A1-4E43-9800-811B0A61EF84&blnFromSearch=1&productcode=US

This is an additional resource that could be used as a part of this lesson. It is a short video containing 6 different sections. The first of these sections is about circuits, conductors and insulators and serves as an excellent way to introduce or conclude the lesson. Additional sections of the video could be shown as the students go more in depth. Other sections of the same video include topics like, different types of circuits and even a section on Thomas Edison.

Conceptual Change:

While working with my fourth grade class it was clear that the students were going through a conceptual change. The students came into the class with many ideas about electricity and how it works but being that it is such an abstract idea, many of their previous conceived ideas were incorrect. During the lesson, I invited students to try lighting the bulb using the materials given to them and what they knew about electricity. The students were able to experiment with the materials and discover some things on their own creating the greatest conceptual change. Some of the groups in the class were slower at finding a way to light the bulb than others. As a result, my teacher jumped in to help them, or other students were quick to share their solutions. I discovered that the students who where able to come to a conclusion on their own, were much more knowledgeable about the materials and understood the greater concept when going over it at the end of the lesson.

While we have discussed science through inquiry in class, I did not realize what a difference it would have in the students overall understanding. The students in the class that had explored the concept with the materials and then came to their own conclusion not only understood the greater concept more in depth than the students who had been told by the teacher or another student, but they were more interested and engaged in the lesson. Since they understood the basic concepts, they became interested in the more complex issues. This lead to some of the students starting to make connections to their own world and discussing how electricity affects them as well as how it works.

When students in the class went through a conceptual change I saw how many more doors it opened for the students and for the teacher to expand on the basic science concepts. Through this inquiry based approach, students are more engaged and therefore more likely to be interested. Teachers should cater to these interests by using additional resources including literature and technology centered on the subject matter being discussed.

While this inquiry based learning, that ultimately leads to a conceptual change, can easily be implemented in the science curriculum, I have also seen how it can be applied to other subjects. While sometimes this happens in a different way, I believe that students can be successful when being taught this way because they are more engaged. As teachers we are always looking for more ways to engage our students and inquiry based learning is an example of how we can do this.

Balancing Mobiles

Madelyn Rohleder

Ideas and Practice

4.05 Describe and observe systems that are unstable and modify them to reach equilibrium.

Students will Have to Know

1. What is equilibrium
2. What is a system and how does it function
3. What are the determining characteristics of instability
4. What is the criterion for creating equilibrium
5. What are ways to modify a system to reach balance

Students will Need to Know How To

1. Modify or change parts of a system so that they are stable and equal on either side
2. Describe, put into words or pictures, what it means for a system to be unbalanced
3. Observe a system by using senses
4. Know how to identify system parts

Explanation of Scientific Ideas

Equilibrium or a state of balance is an extremely broad concept that involves gravity and two forces pushing against one another. When an object is balanced, it can be described as equal or something that has evenness. For example, in terms of weight, it would mean having similar weight when comparing two people on a scale; they are balanced. If the weight is not evenly distributed, the object is not balanced and will fall towards the side that is heaviest.

Sometimes, different types of systems are used to determine balance. A few examples of these can be scales, mobiles, or see-saws. When using a system to determine balance, the weight would be equally placed at either end point causing all of the mass to be concentrated in the center; this is called the center of mass or balance point. On either side of the center of mass, there would be even weight (most likely in the form of weighted objects). If one of the weighted items were different from the other, the center of mass would change.

In order to balance these objects, certain elements of the system must change. This could involve placing more or taking away more weight on either side of the center of mass.

Description of Children's Ideas

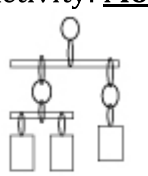
After talking to several of my first grade students, they believe that balance is when something does not fall over. An example would be standing on one foot and using out-stretched arms for support. Additionally, students see balance as relating to gravity. They think that objects have an innate desire to go towards the ground. It is as if these objects have animal like characteristics. In order to balance these objects, they must be supported underneath. This idea begins to develop a concept of using a system.

After several discussions, I discovered that students think that "system" is a specific word used for mechanics. An example would be the engine in a car or the digestive process. They do see it as any series of "parts" that work together to accomplish a task, but limit their ideas to concrete examples. Furthermore, it was extremely difficult for the students to distinguish that a system is actually comprised of parts.

Those students that had some idea of what a system is were unsure of what parts a system uses or requires to complete a task; they lump all of these "parts" together as necessary for all roles. An example of this would be knowledge that the gallbladder and liver are responsible for digesting fats, but in the larger digestive process, the intestines and colon are also important. There is no delineation of different parts for different jobs.

Activities and Resources
Resource: http://www.fossweb.com/
Evaluation: This is a wonderful website that goes along with any of the kits produced by FOSS. It provides interactive games for students, resources for parents, and support for teachers. While exploring this site, I found amazing information for parents and how they can carry science concepts their children are learning in school, back into their homes. Additionally, there are links to research conducted at UC Berkley in the development of these kits. This can be beneficial for teachers who wish to know more about the concepts at hand. Also for teachers, each kit directly relates to standards founded by the National Science Foundation, and the website provides extensive support for that. I think that the biggest asset that FOSS offers is everything they produce (directions, materials lists, parent information, etc.) is available in Spanish.

Activity: **Mobiles for 1st or 2nd Graders**



Materials: Per student/group
1 3 x 5 Index Card (cut into thirds)
1 Jumbo Straw
3 Paper Clips
1 Rubber Bands
Scissors
Thumb Tack

Directions for a 50 minute lesson: To create the mobile, students will take one straw and slip 3 paper clips, through the skinny end, onto the straw. They should be evenly spaced. Next, students will open up the middle paper clip and attach a rubber band. Next, students will attach another paperclip to the top of that rubber band. The remaining 2 paper clips will be left open, and students will place the index cards onto them. Students will first have to cut the index cards into thirds and punch holes in them using a thumb tack. The object is to find a balance with the index cards attached and hang the final mobile on a string across the classroom to see if it is balanced.

The directions stated above are from the FOSS Kit. For my lesson of first graders, I have changed it slightly.

- Rather than having students spend time constructing the mobiles, I have already done so. I found that the process was WAY too difficult for 1st graders.
- Also, instead of just having the students try and balance the index cards, I cut out various shapes. (trapezoid, hexagon, rectangle, heart, and circle) This adds another element of challenge and includes math concepts as well.
- Using various shapes will also encourage the students to think on deeper levels of Bloom's. Example: what do you predict would have if you put 2 trapezoids on one side and 1 circle on the other? Is there any way to balance the mobile with a combination of shapes?
- Rather than students punching holes in the shapes with thumb tacks, I have also pre-punched holes in them for safety reasons. Additionally, this is a modification for students who have problems with sensory-motor skills. The thumb tack holes would be too small to get onto the paper clip.

Evaluation: As a teacher, you do not want your students to spit back information; memorization does not equate understanding. This activity is beneficial for teaching the concept of balance because it requires students to manipulate differing sets of data while actively comparing weights and reevaluating predictions. Students will learn what balance is and how to achieve it through an active exploration in constructing a mobile. Additionally, this activity helps students gather their thoughts. They will be questioned and have many chances to rethink depictions in order to best describe balance. Also, descriptions will be reevaluated with partners so that students may engage in cooperative learning to develop the best possible response. Building mobiles is a specific student-centered discovery of balance with no rote methodology attached.

Transforming Content into Teaching

In the classroom, there is a huge discrepancy between individual students' knowledge and potential; there are no two minds alike. A good teacher tries to modify their instruction in order to meet every students needs, but it is commonly known that this is near impossible.

The theory behind a FOSS kit is extremely effective and is marketed as "cookie cutter" experiments that can be reproduced for every learner. Implementing it to teach science is an easy, collective way to provide interactive activities for certain science topics. The problem is FOSS kits are not individualized; therefore, do not meet all students' ZPD's. The kit shoots down the middle of applying to any 1st OR 2nd grader in hopes of proving beneficial for who ever might be in its path.

There are many reasons that I thought the FOSS kit was not developmentally appropriate. First, the kit required students to construct the mobile themselves. They wanted 6 year-olds to push tiny paper clips through straws and thread rubber bands through the as well. Additionally, the kit asked 1st grades to punch whole in index cards using thumb-tacks. This is not realistic for students who struggle with fine-motor skill discrepancies. In total, the kit required 50 minutes for the mobile lesson, yet devoted nearly 40 minutes of that to assembly. I believe that the active, construction is important, but should not take away from the science concept being taught.

Another reason that I did not like the FOSS kit is because it did not activate any of the students' prior knowledge or experiences. This is an essential part of teaching, and a way to effectively introduce a new topic. When students draw comparisons to their own lives, they can make connections and build knowledge off of that. Along with this aspect, the FOSS kit did not encourage group works. Student should construct knowledge together in order to get the most out of an experience.

The last reason that I do not think the FOSS kit is effective is because it does not provide a framework for essential vocabulary. For ELL students, just throwing vocabulary around already puts these students at a disadvantage for learning. Vital terms like system, modify, and describe are never addressed. There is no basic introduction to words; the kit just assumes that all children know it.

The FOSS kit is a wonderful theory in which science is simplified for teachers and easily taught to students. The problem is the kit does not address all learners; its focus is for the mainstream student. The biggest lesson that I walk away with is that the teacher can effectively use these kits, but must be willing to develop and change them to fit their learners.

How Are Clouds Formed?

Rachel Saylor

Competency Goal 2: The learner will conduct investigations and use appropriate tools to build an understanding of the changes in weather.

Objective: 2.06 Observe and record weather changes over time and relate to time of day and time of year.

Science Skills:

Students need to know:

- Clouds are made up of very tiny drops of water or ice crystals
- The tiny water droplets need something to hold onto, so they form around particles of dust, dirt, or pollutants.
- There must be sufficient water vapor in the air to build a cloud.
- The air temperature must decrease enough for water vapor to condense.

Students need to be able to:

- Make observations about what is happening in the bottle
- Draw conclusions about what they saw in the bottle and what they know about how a cloud is formed.

Explanation of scientific ideas:

What are clouds?

- A cloud is made up of very tiny drops of water or ice crystals that are so tiny they can float in the air. When you see clouds up in the sky, this is what they are made of.

How are clouds formed?

- The temperature up in the sky is much cooler than on the ground, so when the warm air rises it cools and stretches out. The cold air can't hold as much water vapor as warm air, so the water vapor changes to liquid, and a lot of droplets form. The tiny droplets need something to hold onto so they cling around particles of dust, dirt, or pollutants. When a lot of these droplets come together they form a cloud that can be seen from the ground.

What is water vapor?

- Water vapor is water in its gaseous state.

(Benchmarks, 2008)

Description of children's commonly held ideas:

Where do children get their assumptions about how clouds are formed? I don't think there is a wrong or right answer, but I do believe that children construct their own ideas about concepts not only based on their own experiences, but also by observing what others do or say. Children don't know any better, so when asked how clouds are formed, they came up with a variety of answers.

- "Clouds come from somewhere above the sky."
- "Clouds are formed by the water in the ocean."
- "Clouds are formed from the water vapor that leaves pots."
- "Clouds are made of cotton, wool, or smoke."
- "Clouds are made of air."
- "The reason clouds form is because cold air doesn't hold as much water as warm air."
- "Water breaks apart when it becomes a gas and it disappears when it evaporates."
- "Water and air connect and go into the sky."
- "Water evaporates into a container"

(Beaty)

In reality clouds are made up of very tiny drops of water or ice crystals that are so tiny that they can float in the air.

Activities and resources:

- To get students thinking about how clouds are formed, TTW ask the student's questions about how they believe clouds are formed. Then using their prior knowledge, TTW guide the students on a quest to come to their own conclusions about the true way a cloud is formed. For students to come to their own conclusions about how clouds are formed the class will participate in "cloud in a bottle" activity.

Cloud in Bottle:

Materials:

- 4- 2 liter bottles
- Wooden matches
- Boiling Water

Process:

- TTW fill each 2 liter bottle with 1/3 cup of boiling water, and place the cap back on
- TTW ask the students to observe what is happening
- TTW then ask the students to squeeze the bottle and then observe what happens.
- TSW see that a cloud is not being formed (what do else do we need other than water, so that a cloud can form?-dust)
- TSW turn the bottle on its side so that the water washes over the walls of bottle

- TTW will then ask the students to take off the cap, and the teacher will carefully light a match and place it near the opening of the bottle. The TTW drop the match into the bottle.
- TSW place the cap back on quickly so the smoke doesn't escape from the bottle.
- TTW instruct the students to squeeze thebottle until they see a cloud being formed
- TTW ask, "What happens when you squeeze the bottle?" (There is not a cloud)
  "What happens when you release?" (A cloud forms)

Explanation:

This activity helps children understand how clouds are formed because they are visually able to see how water and smoke are a part of what we need to make a cloud. Then to represent the cooling in the atmosphere the students can use their hands to squeeze and release the bottle. After the students have released the bottle they see a cloud form. It is always useful for students to visually see a scientific concept come to life, because then it becomes a real life experience rather something the teacher just told them about.

Resource:

I took the idea for the "cloud in a bottle" activity from a book called *Weather*. There are other activities in this book other than this activity which are all great activities that have to deal with weather. All of the activities have an essential question, list the materials needed for the activity, list the steps for doing the activity, tell you what should be the ending result, tell you why the activity gave you the results that it did, asks you to repeat the activity so that you can explore a different result, and finally invites you to explore other ideas about the subject. This book is a great resource to support student learning because each activity doesn't just give the procedure, but allows the students to use their hands to explore the subject that they are learning about. It is great that at the end of each activity it tells students to repeat the activity again by doing it differently. If students are able to do the same activity a different way, then they can compare and contrast the two ways, and can see why the materials they utilized were important in creating the ending result.

Transforming Content into Teaching:

In our class, we have previously talked about using student's previous knowledge and letting them come to their own conclusions. I was not able to teach this lesson to my second grade class because of time. However just by teaching this lesson in our methods class I could see how everyone was using their previous knowledge about how clouds were formed, to figure out what materials they would need to make a cloud form in their bottle. As well as letting everyone in our class figure out what materials needed to go into the bottle to make a cloud, I also had them come to their own conclusions about how they were going to actually form a cloud in a bottle. In our class we have previously discussed how important it is to let children come to their own conclusions about how things work. I was a little nervous about letting our class figure out how to do this on their own simply because I didn't know how they were going to figure out how in the world a cloud was going to form. Surprisingly enough everyone figured out that in order to make a cloud they had to squeeze and release the bottle. I can see now why this method is the best way to teach. Instead of telling children how to do something, they are able to construct their own meanings from the information that is provided, which makes learning more meaningful.

Investigation into Motion – Spinning Tops

Ben Smith

Ideas and Practices:

NCSCOS Objectives: Science, Grade 1

Competency Goal 4: The learner will make observations and conduct investigations to build an understanding of balance, motion and weighing of objects.

Objectives :

4.01 Describe different ways in which objects can be moved.

4.02 Observe that movement of an object can be affected by pushing or pulling.

4.03 Investigate and observe that objects can move steadily or change direction.

Students will:

- Explore the causes of and how to produce rotational motion
- Explore how spinning objects move and react to variables
- Experiment with weight distribution and its impact on rotational motion
- Make meaningful observation of factors that facilitate stable spinning motion and which factors impede it
- Explain and demonstrate, to the teacher and peers, what it means for a system to be stable/balanced and how stability is achieved
- Judge if a system (a top) is likely to be able to spin stably based on the observations of successful top designs

Explanation of scientific ideas and practices:

Motion results when a force acts on a system. We say something is balanced when it has reached a point of equilibrium. Equilibrium does not mean a system has not forces acting one it. It means that the forces that are acting on the system counteract each other. This is important for the lesson on tops because a system can achieve what we call balanced, but still be moving.

Rotational motion, more simply referred to as spinning, is when an object moves in a circle around a central axis. A special force, called torque, is responsible for making systems spin. While applying a simple force to a system can put it in linear motion, torque is a force that moves one side of a system in one direction, while moving the other side of the system in the opposite direction, thus causing the system to spin.

The behaviors of spinning toys, like tops, show a lot about the properties of rotational motion. The shaft of a top serves as the central axis, or axis of rotation, around which all the weight of the top is evenly distributed. If the weight distribution is not even around the shaft, the top will not spin properly. A top becomes more stable the heavier it is, the closer the weight is to the bottom of the top, and the faster it is spun. A top remains upright when it is spun, balanced on the tip of its shaft, but as it slows down, it eventually falls over because it loses its stability.

Paraphrased from Background Information, Investigation 2, Balance and Motion Module, FOSS Kits

Description of children's commonly held beliefs:

I was not very successfully at extracting concepts from my students when talking to them informally about the subject before the lesson. If they did have perceptions, I was not able to get them to verbalize them to me when I talked with them. Additionally, this topic does not seem to be relevant enough in the science curriculum for research on children's perspectives or misconceptions to be available online. However, I did make observation of their perceptions as they were being changed during the investigation. Some students perceived the success of a spun top as solely due to how good of a spin the top was given (not necessarily just speed though). Few recognized before the lesson that weight and distribution were factors. Rather they thought a top remained spinning longer due to luck, or a "good spin" by someone with a perceived talent for spinning. IN reality, though the speed of the top has an influence on the stability, the stability of a spinning top is impacted more by the quality of the top (effective weight distribution) than by the quality of the spin. For most students, this perception changed somewhat with the investigation.

Student at the age understand something to be balanced if it doesn't fall over. Therefore, balancing a top offers a unique situation, because every top eventually falls over. This leads children to perceive that a top loses its balance when it slows down – it was balanced, but now it's not anymore. This is a misconception, but a useful one cause it is simply the mixing of a multiple true concepts – that how long or well a spinning object reflects how counteracting forces are working to maintain balance, and that the faster an object is spinning the more stable it behaves.

Activities and resources useful to teach ideas and practices:

To teach this concept, I taught the lesson from the FOSS Science kit.

> Parts 1 of Investigation 2, Balance and Motion Module, Grades 1-2
>
> Developed by Full Option Science System (FOSS), University of California, Berkeley CA
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> Published and Distributed by Delta Education, Nashua, NH

The activity of this lesson is top building. After a class conversation about terms, what spinning was, how tops worked, and how the activity would be run, students are each given supplies that could be used to make a variety of tops, and challenged to make the most stable top they could. Supplies include a thin straw to be used as the top shaft, and four circular plastic disks of two different sizes that can be placed on the straw to make a top. They are given a large chunk of time to explore, share and compare ideas with their classmates, and experiment with different methods of meeting the challenge, before the class is called back together to discuss students' findings.

One of the main objectives of this lesson is to teach about different types of motion, and this activity is very effective at familiarizing students with the concept of rotational motion. It is especially effective at constructing students understanding of how other factors, like weight distribution, impact rotational motion. The students are given very little instruction on building an effective top, so they must discover themselves what factors contribute to a top's stability, and what factor take away from it. By this process, students develop conceptual understandings of weight distribution and spinning in context relevant to them.

Also in this lesson, students are encouraged to exchange ideas with their peers. For example, if they believe they have met the challenge (built the most stable top) then they are challenged to have a competition between their top and their neighbors' top. Students are also encouraged to share successes and failures with their neighbors. This ensures that even students that don't come across certain concepts in their individual explorations are still exposed to the concepts, and it does not have to come from the teacher.

This whole unit science kit and associated lesson plans are an exceptionally useful resource. They provide all the necessary tools and instructions, ranging from simple practical tips, or explain concepts for teacher understanding, to strategies for integration. The resource is a complete and well-produced kit for leading a complete inquiry based science unit, which as a unit achieves all the learning objectives associated with the science concept.

Resource: Tops and Other Spinning Toys by Beth Dvergsten Stevens

This is book of pictures of many different tops and other spinning toys. This would be a great resource for this lesson because students could use what they learned from their top building experimentation to make predictions about the tops and spinning objects they see in the book. You could ask students which objects they think would spin better, and which might have a had time spinning, and follow up with having they explain the qualities of the toys the choose that make them think that. It also gives students an opportunity to observe a wide range of objects capable of spinning, giving them the opportunity to make observations about what objects that spin have in common and what factors don't influence the ability of something it spin. Also, by seeing spinning objects that aren't tops, students will form a wider understand of what it means for something to spin. This resource can be used is many way to expand on the lesson, exposing students to more thing that spin and therefore expanding their concept of spinning and motion.

Transforming content into teaching – how do theories inform practice?

This is a strong science lesson not just because it is inquiry-based, but it is also highly learner-directed inquiry and takes opportunities for classmate collaboration – two features of highly effective science teaching. In this course, we have thoroughly discussed why inquiry science is the strongest way to teach science concepts, but science inquiry exists on a continuum between teacher-directed and learner-directed. In Jo Anne Vasquez's Tools and Traits for Highly Effective Science Teaching, K-8, there is a chart that breaks this continuum into levels, by looking at the essential features of classroom inquiry. The following analysis is based on that chart, and shows that this lesson falls between level III and IV at the learner-directed end of the spectrum. Though the challenge is provided by the teacher, students create their own questions about the concept in the process of meeting the challenge. In the process of testing their different top designs, the students are creating a procedure for gathering evidence. Though the students are probably not even conscious of it, they are gathering data and analyzing it as they improve their top designs. During inquiry and the activity closing, students are guided in formulating explanations for their findings. They are also guided in making connections between their explanations and a scientific understanding of motion. Lastly, students communicate information freely and without direct instruction. Students are encouraged to share successful techniques with their neighbors, and in doing so, they communicate their understandings of the concepts. In addition to being student-directed inquiry, this component of collaboration and the sharing of ideas make this lesson strong. "One of the shared values that is a foundation of our science program is collaboration" (Reddy, et all., Creating Scientific Communities in the Elementary Classroom, pg. 20). Though students are given their own materials and encouraged to conduct their own inquiry, the collaboration element provides an opportunity for students who "get it" to strengthen their understanding through communication, and provides assistance (not from the teacher) to students who might struggle with their own inquiry. Overall, the lesson is strong because of its foundation in student-directed inquiry, and it's incorporation of collaboration in what could have otherwise been an individual task.

While teaching this lesson to my 1st grade class, I found these components very effective. The inquiry truly did feel student-driven, and student grasped the concepts, either through their own inquiry or communication with their peers, and I had to do very little in terms of direction. I simply reinforced the concepts, and assisted students in connecting their discoveries to scientific understanding.

Click It- Reinvention of the Telegraph

Becca Wells

Ideas and Practices

1. NCSCOS Objectives

Goal 3: The learner will make observations and conduct investigations to build an understanding of magnetism and electricity.
Objective 3.03
Design and test an electric circuit as a closed pathway including an energy source, energy conductor, and an energy receiver.
Objective 3.08
Observe and investigate the ability of electric circuits to produce light, heat, sound, and magnetic effects.

2. Practices

Students would need to know that:

1. Technology and science work together, thus technology uses science to solve problems and create new devices.
2. Electric currents flow through a circuit.
3. Magnetism created by a current that surges through conductors is called electro-magnetism.
4. Morse code and the telegraph were developed by Samuel Morse in the mid 1800's.

Students would need to be able to:

5. Use their knowledge of electricity and electromagnetism to reinvent the telegraph.
6. Connect all parts into two very large circuits with a battery and switch.

Explanation of Scientific Ideas

Magnets are really neat objects because they have a force that allows them to attract or repel other objects. However, this is a force that cannot be seen. That is how regular magnets work but electromagnets are different. An electromagnet uses electricity to make a magnet that has a magnetic force. In order to make an electromagnet we would need electricity flowing through a circuit. This circuit must be a complete circuit so that the electricity flows in a circle. When a circuit is open, the electricity is not flowing but when it is closed the electricity is flowing.

Long ago, a land without telephones existed, making communication very different than it is today. A man by the name of Samuel Morse created an invention that used electromagnets and circuits to make long- distance communication possible. This invention is called a telegraph. A telegraph allows for the transferring of messages back and forth. This shows how science and technology work hand in hand. If Samuel Morse didn't have any knowledge about the scientific concepts about electricity, creating the piece of technology that he did would have been impossible. It took a few tries to get this piece of technology working and once Morse did, it changed communication forever.

Since we have already created electromagnets, we are now going to use our knowledge of creating electromagnets to reinvent the telegraph and create a device that can create sound and use Morse code. Morse code uses different patterns of sounds to create letters so in order to understand the message being sent to you, you had to know Morse code. In order to reinvent the telegraph a circuit base, D-cell battery, electromagnet wire and short wire will be used. It is important to remember that in order to make the device work, students must make a complete circuit, one that goes in a circle so that the electricity flows through. Since students worked through creating electromagnets the week before, they should know that they need to wrap the rivet so that the electric current will pass through it as well. Students may encounter difficulties along the way as wires can get crossed and students will have to use problem solving skills to create a device that works. This struggle will allow students to learn more about electricity and refine their skills.

<u>Description of children's commonly held beliefs</u>

Concepts of electricity and magnetism can be difficult concepts for students to get a grasp on. Hands on experience however, will allow them to interact with these concepts and experience them first hand. Since students had just recently completed an assignment on electromagnets and electricity the students had a grasp on the concepts. When asked about electricity many related it to the battery activity they completed. A few students told me that if a battery has enough power it can light two light bulbs but if it is too powerful it will explode. Others told me that electricity is a shock and you can create it using light bulbs and wire. It can also travel through water and solids but if people touch electricity when it touches water they can get electrocuted or shocked. Most students knew that electricity is what makes things work and is used to power much of the everyday things that we use.

The concept of a telegraph is something completely foreign to almost every child in the class. Many had no idea what it was and others thought that it was something else. Due to the fact that telegraph has the word graph in it, many related it to being a type of graph used to measure things in mathematics. This is most likely because students are currently working on graphing in math class. The telegraph was a way of communication that existed before there were telephones and computers. It was during this time that it was discovered that electricity could travel through wires and this was linked to creating a new way of communication.

Activities and resources useful to teach ideas and practices

This lesson will provide very hands on experience that allows students to work with and manipulate wires and batteries to create their own telegraphs. Students will work in groups and each group will get one circuit base to build their telegraph on. To create the telegraph each group will need:

1. 1 circuit base
2. 1 rivet
3. 1 electromagnet wire – 150 cm long (yellow)
4. 1 short wire – 15 cm long (red)
5. 1 switch
6. 1 D-cell battery, alkaline
7. 1 steel strip

This is a very useful idea because it allows students to take part in science. Rather than just listening to an explanation of the telegraph and science concepts it uses they get to try it, explore and investigate. Rather than telling students exactly how to build it, students will try building the telegraph themselves. They will have a few hints to guide them such as the two indentations that exist on the circuit base are where the rivet can be placed. To introduce this lesson, students will be read a story from the FOSS Science Stories: Magnetism and Electricity. This story introduces the telegraph and gives background information on Samuel Morse, which gives the students a clearer picture of what life was like during the time the telegraph was invented. Students will then be handed out the materials and begin working on their telegraph. The students will know to start by building an electromagnet, which they already know how to do as they completed this in the previous week's lesson. If students correctly build the telegraph by are having trouble making the ding noise, then the teacher can help to explain that the gap between the steel and electromagnet has to be just right. If the gap is too small the steel will just stick to the magnet and if it's too big it will not be close enough to be attracted to the electromagnet. Thus the students will have to play around with the distance of the electromagnet. Students will be reminded that the circuit must be closed for the telegraph to work so that the electricity will flow through. When students are through they will copy their invention into their science notebook and make sure the switch is open so the batteries will not be drained.

Transforming content into teaching- how do theories inform practice?

This lesson fits in perfectly with the concept of "acquiring scientific habits of mind". As stated in <u>Creating Scientific Communities in the Elementary Classroom</u>, "It is not enough to tell children about the values that scientists hold...values are transformed into attitudes when they become tools that children use to regulate their own thinking" (p. 18). This lesson does not directly tell students what to do but allows them to investigate the concepts themselves. Prior to completion of this lesson students will have completed an investigation on electromagnets and thus will have some prior knowledge. Students will then use their prior knowledge and the schema they have created for an electromagnet to build a telegraph on the circuit board. Since students are able to physically manipulate with the materials the concepts are no longer just concepts but become more concrete as students can see how they can be applied and used.

This seemed to be true as I observed students as I taught the lesson. The students were very engaged in the lesson because they found it interesting and “cool”. Since they could actually physically build it themselves and not just observe me build it they felt that they were a part of the process and thus has better attention. They used what they knew about an electromagnet and applied it to building the telegraph but then continued to build off of that to complete the invention. This pushed their thinking a little and required them to reach a little further for their knowledge and try new ideas.

Clouds (As part of the weather unit)

Kendall Wetzel

1. Ideas and Practices

NCSCOS Objectives:
Competency Goal 2: The learner will conduct investigations and use appropriate tools to build an understanding of the changes in weather.

2.06 Observe and record weather changes over time and relate to time of day and time of year.

The students will observe and record weather changes; for this lesson they will observe and study cloud types and related weather will be showing the class pictures of various types of clouds and asking them to reflect and describe what the clouds look like. They will be writing down their observations and sharing them orally. The students will demonstrate their knowledge by making observations and taking recordings of their observations.

2. Explanation of Scientific Ideas

A cloud is a name given to tiny droplets of water suspended in the atmosphere. The tiny droplets exist because water vapor has condensed together. Water vapor is water, that when exposed to air it dries up (evaporates) and transforms into the gas form of water. This occurs when a humid air- mass has been cooled by rising up in the atmosphere or has come into contact with air that is cooler than the air-mass. The change in temperature affects the water vapor and transforms its physical properties. Observing clouds may give great predictions about the weather. The color and shapes of clouds tell you what type of cloud is it and what type of weather those clouds may bring. There are three basic types of clouds: Stratus, Cirrus, and Cumulus. Stratus clouds are typically flat or layered and gray. They are the lowest clouds. Cirrus clouds are the highest and whitest clouds. They are curved or wispy. These clouds do not bring precipitation. Cumulus clouds are very fluffy and cotton-like. When the term nimbus is with any of these clouds that means that precipitation will follow.

Wind affects how clouds are formed, as well as how they move. If there is a gentle uplift of air flow then the clouds are more likely to running horizontal. On the other hand, if the air flow is strong and upward than the clouds will appear vertical (Wenham, 2005).

3. Children's Commonly Held Ideas

I interviewed two of my students casually during lunch time. One of the students I would classify as an average student and the other student has severe ADD. The average level learner told me that he thought clouds were made up of air and maybe some water. He justification was that rain comes from clouds. When I asked him to describe different types of clouds he told me there were white and gray clouds. Gray clouds brought rain and he did not know why white clouds existed. The student with severe add told me that clouds were made out of smoke. He expressed that clouds were created from fires; the smoke goes in the air and eventually becomes clouds.

Research in the text, *Children's Ideas in Science* stated that children often have trouble understanding states of matter. Since clouds are formed from water changing into various states of matter I found this research quite beneficial. For example, the text stated that young children frequently believe that water and steam are two completely different things. They do not understand the correlation between the two (Guesen, E., & Tiberghien, A.).

4. Activities and Resources Useful to Teach Ideas and Practices:

I am using the classroom science kit to teach this lesson. The kit supplies me with a cloud poster called A Guide to the Sky. This poster shows various types of clouds and how they look in the sky. This poster will be useful to show students what the different cloud types look like in real life. Although the poster is a great resource, I did not think the pictures were big enough. So, I made a Powerpoint of pictures of the three types of clouds. I will have the students look at the clouds and write down descriptions of what they think the clouds look like. I will then ask the student to share their observations. In correlation with the poster the kit provides me with a book entitled <u>What's the Weather Today</u>. The book provides great illustrations of clouds and will help lead the class into a discussion on weather. Questions I will raise after the book include: what type of clouds were present in various pages in the book, how long does it take for the weather to change, what can clouds tell us about the weather, and why do clouds turn gray? The story will help summarize the lesson and led to future lessons in weather.

After going over what a cloud is and talking about the various types of clouds, the students will complete an activity. For my activity I am having the students create mini-posters that displays the three types of clouds. Students will use blue construction paper, cotton balls, glue, and markers. Students will divide the construction paper into four. Then, they will label the first box "clouds", then every other box gets labeled a name of a cloud: status, circus, and cumulus. The students are then asked to create models of each type of cloud using their cotton balls. I am using this activity to ensure that the students understand what each type of cloud looks like in the sky. Their posters will let me know if/ how they observed the cloud forms. While the students are working I will walk around the check progress and ask questions to check comprehension.

5. Transforming content into Teaching- How do Theories Inform Practice?

In my current placement the class is in their weather unit. My cooperating teacher asked me to use the science kit and teach the lesson about clouds. The kit included the poster, the book, and suggested taking the students outside to view clouds. I wanted to supply the class with larger, more detailed pictures of clouds than the poster offered; therefore, I made the Powerpoint of cloud pictures. I thought that looking at the pictures of clouds and asking the students to describe what they saw would be significant observation. The students seemed to be very excited about the cloud pictures. I was impressed by their detailed and creative descriptions. I had the students write their descriptions in their science notebook. I thought this would help them to remember the cloud types for the future and it would be a resource for activity I planned. I also had the student verbally share their observations with their classmates, so that they could learn from one another and understand the differences in the clouds.

I wanted the observations to "stick" with the students, so I went into further discussion with my class. I encouraged the students to think back upon times when they saw the types of clouds I was showing on the board. I then asked questions such as: what did it feel like when you saw this cloud, was there a lot of wind when these clouds were present, did it rain, snow, or hail while/of after these clouds were around? These questions were aimed to dig into the students schemas of clouds. I wanted the students to reflect on their past experiences in order to pull these memories up and build knowledge surrounding them.

Our class text, Tools and Traits informs readers that children are not blank slates. I knew going into the lesson that every student in my class had had some experiences with clouds (Vasquez, 2008). I wanted to take full advantage of those experiences and have the students share them with one another. I wanted the students to listen and absorb their classmate's descriptions and experiences. I also wanted to inform the students that what were going to be learning about was relevant to their everyday lives. Clouds are part of the sky we see almost everyday; learning about clouds can lead to insightful weather predications for daily life.

While teaching my lesson I had students sitting together for a class discussion about clouds. I could tell I was activating their schemas on clouds as they were eager to raise their hands and inform me and their classmates about their past experiences. From our class discussion and from my interviews with students I found out the students concepts on clouds. I then aimed for conceptual change on my students understanding of what clouds really were. My students were aware that clouds brought rain, snow, etc. so I pointed out to them that obviously clouds needed to contain water.

As I observed and assisted the students build their mini-posters featuring the three major types of clouds I asked them questions to check their understandings. I learned that to achieve the conceptual change I aimed to achieve I would need to teach an addition lesson. This other lesson would go more in-depth into cloud formation and the process of precipitation (Watson, B., & Konicek, R, 1900). Since my teacher asked to me specifically teach the science lesson from the kit, I was unable to teach and additional lesson and did not reach the conceptual change that I aimed to teach the class.

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