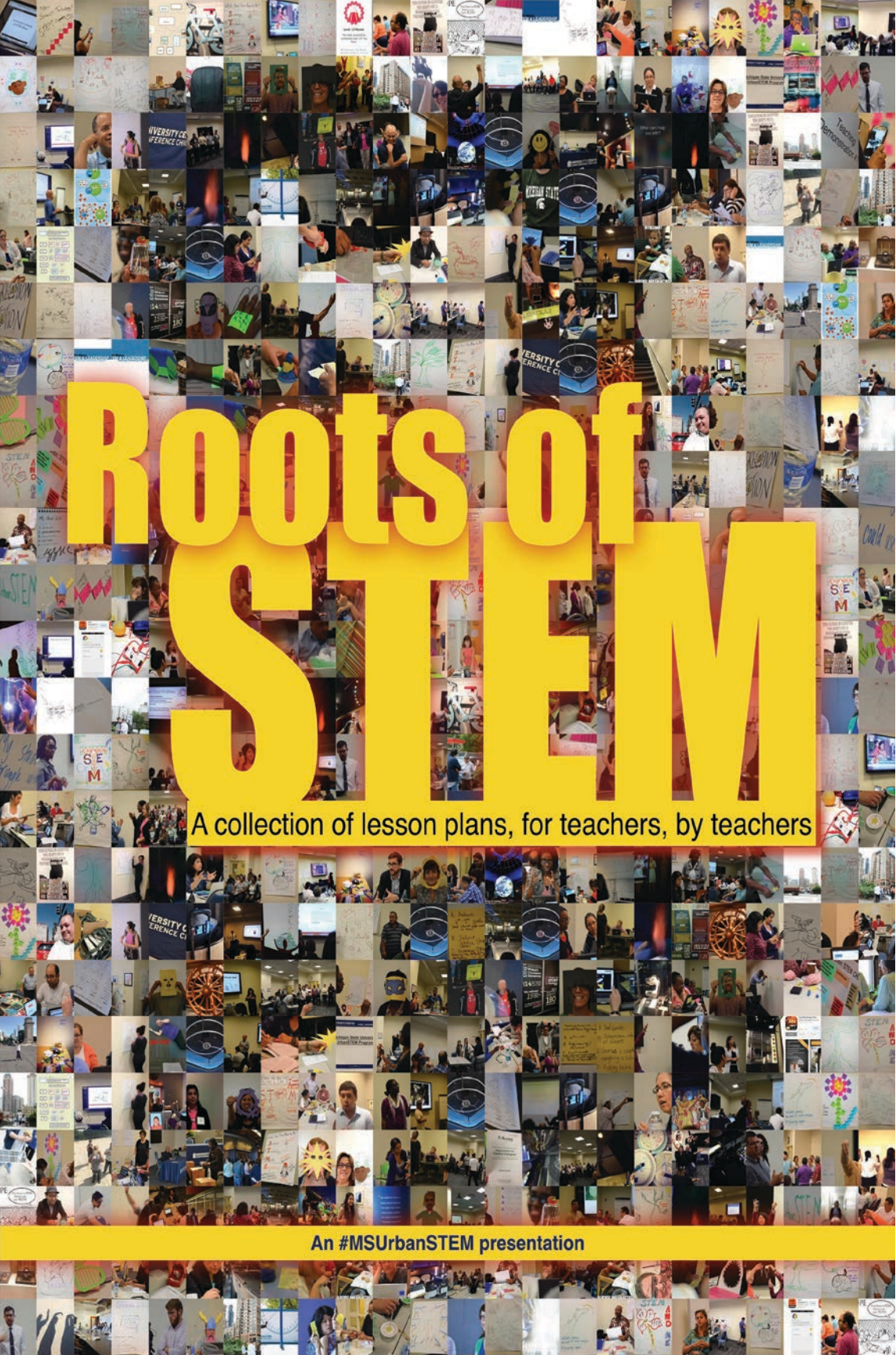

Roots of STEM

A collection of lesson plans, for teachers, by teachers

An #MSUrbanSTEM presentation

Roots of STEM

A collection of lesson plans for teachers by teachers

A product of the MSU-Wipro Urban STEM &
Leadership Fellowship Program

Michigan State University
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#MSUrbanSTEM

September 2014

It is the supreme art of the teacher to awaken joy in creative expression and knowledge—Albert Einstein

This book is dedicated to teachers everywhere who strive every day to awaken this joy.

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Preface

Some teachers don't truly end their day when the last school bell sounds. For them, that last bell denotes time they can dedicate towards reflecting on the day's events; including what worked in their teaching practice, as well as what can be improved. They might use the time to confer with colleagues about the best ways to differentiate instruction for the wide range of learners in their class each period, or discuss method in which they can work collaboratively across disciplines. These teachers also consider what tools might enhance student learning and engagement, and thoughtfully consider how the intersection of technology, pedagogy, as well as their content knowledge interplays during their lessons. This book is aimed towards that reflective educator.

STEM educators in the Chicago Public Schools wrote this book. These educators were selected by the College of Education at Michigan State University, in partnership with Wipro, to participate in an innovative, integrated year-long graduate certificate experience aimed at building STEM teachers' capacity to lead and inspire innovative practices in urban K-12 schools. Participants in the program were selected through a rigorous process based on criteria which including commitment to teaching in urban schools, deep knowledge of content, and prior achievement and evidence of promise within the field.

This book is a unique resource for educators. It provides 25 STEM lessons for teaching a wide range of content. While this book is primarily geared towards K-12 educators in the STEM fields, it offers ideas for teachers across disciplines. The reader of this book is provided with a plethora of ideas and resources for expanding the lesson to individualized context.

How this book came to be

In creating this book, each of the STEM educators in the program selected a lesson from their own teaching repertoire, aimed at showing their best work. Following the selection of this lesson plan, every teacher delivered a 30 minute condensed version of the lesson to a small group of fellow class members and educators. This offered an opportunity to solicit extensive peer feedback, as well as a unique chance to share ideas and dialogue after the presentation of each lesson.

The feedback from peers was particularly focused on looking at the learning experience through the lens of several themes, including:

- Teachers As Learners (Considering the lesson from the eyes of a student)
- Elements of Pretty Good Practice (Promising practices from the lesson)
- Extensions and Adaptations; (identifying adaptations and extensions for alternative settings and/or for longer durations)
- Questions Arisen (Questions that come up about the content, the pedagogical approach, the use of technology, or any other questions).

This extensive process of sharing best work provided an opportunity to be exposed to new ideas in regards to pedagogical approaches and content approaches – then examine them collectively and methodically. After this iterative process, each teacher assembled their ideas together into a consistent format, that includes key descriptive aspects of their lesson, along with the themes above, feedback received, as well as bibliographic and reference details.

Each of the lessons given here is distinct in that it not only represents the best lesson of the teacher who selected and presented it to their peers, but it also reflects the ideas and takeaways of the other teachers who provided feedback on it. In fact, the peer teachers went beyond giving feedback, but also explored the possibilities for modifying the lessons and pursuing them in other teaching contexts. Therefore, a nice range of teaching perspectives (from educators across different STEM content areas, age/grade levels, and school contexts) is contained within each lesson here. The results of their collective effort have been collated into this book. In this way, it is a labor of love describing some of their best approaches and lessons for STEM teaching and learning – which they have graciously shared in the pages to follow.

Please e-mail your comments or questions related to this book to msuurbanstem@gmail.com. All feedback is welcome, especially information about what you found most helpful, as well as what you would like to see included in future editions.

Acknowledgements

This book (and the program that helped create it) is the result of the hard work and effort or a large team of people.

First and fremost, none of this would have been possible without the generous support of Wipro Ltd. and their commitment to education in the STEM disciplines, particularly in urban districts such as Chicago. We would specifically like to thank Anurag Behar of Wipro and the Azim Premji Foundation for his efforts in making this project a reality.

We are also grateful to Microsoft for their donation of Surface Pro tablets for the first cohort of teachers in our program. A special thanks to Dr. Jim Ptaszynski, Senior Director World Wide Higher Education for making this happen.

We would also like to thank Chicago Public Schools for their partnership. In particular we would like to mention Aarti Dhupelia, Chief Officer of College and Career Success; Will Hobart, currently Executive Director, Office of Student Support and Engagement; Litrea Hunter, Chicago based recruitment and sustainability coordinator; and Lana Brown, outreach specialist. This has been a genuine partnership between MSU and CPS and these individuals are among many who have made this possible.

There are numerous people at Michigan State University and the College of Education (too numerous to mention) who have helped in ways large and small in making this project a reality. We would like to

specifically thank Dean Don Heller for his support; Marcy Wallace for helping navigate the intricacies of budgets and other red-tape; and Jessica Pham and Heather Johnson for administrative support.

The planning, technology and evaluation team at MSU consisted of (in alphabetical order) Michelle Hagerman, Day Greenberg , Alex Lishinski, Inese Berzina-Pitcher, Christopher Seals and Andrea Zellner. These are the people who worked at super warp-speed over the spring semester to get everything set for the next three years—an incredibly challenging task. Specifically, this book was the brain-child of Andrea Zellner, with additional help from Day Greenberg. Akesha Horton took the lead in providing feedback and sheparding the writing process; Kyle Shack cleaned up and organized all the documents in consistent form; and Alex Lishinski built the pages for the eBook and the printed volume. Thanks also to Johan Magar, Expresso Book Machine coordinator at MSU Libraries, for helping with the printing process. The cover was created from photographs taken during the summer session of 2014 and designed by Punya Mishra, using MacOSaiX software.

We would also like to thank the leadership team at MSU: Dr. Punya Mishra, Dr. Sonya Gunnings-Moton and Dr. Leigh Graves Wolf. Their commitment to excellence in teaching in general, and to urban education and educators in specific, can be felt in every aspect of the program.

Finally, a heartfelt thanks to the 25 teachers who are the first cohort of the 2014-15 MSU-Wipro Urban STEM Teaching and Leadership fellows. This project runs on their shoulders. These 25 lessons are testimony to their creativity, passion and concern for excellence in STEM learning. They often work in challenging contexts with multiple pressures on their time and energy. It has been our privilege to work with them and learn from them and we thank them for giving us this opportunity.

Sincerely

The MSU-Wipro Urban STEM
Fellowship 2014 Teaching Team

| Punya Mishra | Akesha Horton |
| Candace Marcotte | Kyle Shack |

September 2014, East Lansing MI

Chapter 1

Adrienne Keiner: Mangia! Mangia!

I am a current Chicago Public Schools teacher. I have taught 6th grade mathematics for the past 3 years. Before I moved to 6th grade I taught 8th grade math and science for 7 years. Apparently I was born to teach! I my job. I can't imagine doing anything else in the world. However, I fought very hard not to become a teacher. I completed my undergraduate degree at Loyola University. I did not plan on becoming a teacher. I actually didn't know what I wanted to do with myself, until 2001. After 9-11 I knew I had to be a force for change. How do you get people to change? You teach it! I completed a Masters in leadership from Concordia University, and a Masters in Science and Mathematics from University of Chicago. I am forever a learner. If I think I know everything, I should probably retire.

Mangia! Mangia!

Grade Level: 6th
Content Area Topic: Math - Dividing using fractions
Content Area Standard(s): 6.NS
Learning Objective(s): Mid-unit assessment of dividing fractions while incumbusing previous units.
Suggested Time Allotment: 1-2 days or 60-90 minute period

Sequence in Learning:
See presentation on website

- Review how students use division and/or fractions
- Review how students have used division and/or in class or other classes
- Have students pair up via learning level and visit khan academy on an ipad or laptop. Students should have already logged on to create an account in previous class periods.
- Students should watch 2-3 videos from Khan academy to review what has already been taught in previous classes.
- Partners should switch journals and practice example problems from previous lessons.
- Teacher will than review several different ways to divide fractions. Include any tricks or tips that have been previous taught.
- Reveal the directions for putting their snack together. Remind students that the teacher will be walking around and observing communication and application. Directions will lead students and teacher will be just facilitating.
- Allow students a good amount of time to complete the mathematical steps and recipe.
- When students are complete or time is up have a whole class discussion on the "epic failure", "Indiana Jones'", and "questions".
- The discussion will lead the teacher to a mid unit assessment and what the class should move onto next.

Materials & Resources Needed:
Easy Dry recipe: soft copies and hard copies (Chex Mixes are awesome!); all materials for recipe; Mangia! Mangia! (Powerpoint for lesson); Large poster paper; calculator; chrome books, laptops, ipads (for www.khanacademy.com); Student journals; Extra paper; Pencils.

Lesson Activities & Sequence:
Following the attached power point
5 min. Review how students use division and/or fractions
5 min. Review how students have used division and/or in class or other

classes
3-5 min. Have students pair up via learning level and visit khan academy on an ipad or laptop. Students should have already logged on to create an account in previous class periods. (Teams should be 2-3 students deep and leveled according to a pre-assessment related to fractions.)
10 min. Students should watch 2-3 videos from Khan academy to review what has already been taught in previous classes. (At risk students should be given specific videos to re-watch)
7-10 min. Partners should switch journals and practice example problems from previous lessons.
7-10 min. Teacher will than review several different ways to divide fractions. Include any tricks or tips that have been previous taught. (only review 2 ways that have already been taught)
1 min. Reveal the directions for putting their snack together. Remind students that the teacher will be walking around and observing communication and application. Directions will lead students and teacher will be just facilitating.
20-30 min. Allow students a good amount of time to complete the mathematical steps and recipe.
2-5 min. for each part - When students are complete or time is up have a whole class discussion on the "epic failure", "Indiana Jones"', and "questions".

The discussion will lead the teacher to a mid unit assessment and what the class should move onto next.

Proficiency: Students will be able to divide fractions into reasonable measurements to complete the recipe.
Students will be able to see mistakes and make corrections.
Students will be able to discuss the above and communicate findings accordingly.
A final paper/pencil assessment will be given at the end of the unit.

Feedback

Teachers As Learners:
Warm, inviting lesson, exhilarating, not intimidating. This approach is fraction friendly and takes the stigma off. Food is a natural extension for fractions. Appropriate mix of touch and tech.

Videos and review efforts worked very well for all learners. Remind students of other elements such as measuring and scale. These unit should be taught before this specific standard.

Elements of Pretty Good Practice:
Hands on, kinesthetic learning. Activated prior knowledge, appropriate technology use. Used alot of guiding questions. Students were sharing their notes. Required students to calculate before using the materials. Used friendly knowledge (KCF) to explain the approach.

Modifications and Adaptations
Using KFC instead of KCF. KCF would stand for keep, flip, calculate. In certain schools this may be extended to a 2-day. Extend it to a cultural food fair/International Day to invite families. Another extension is to make it for 100 people. Look into Common Threads to incorporate afterschool programs (Food and Science)
At risk students should have a recipe that has only 3 steps, as well as a step by step poster.

Questions Arisen
How do you assess the prior knowledge of fraction before starting this activity? How do you assess the outcome of the experiment for Indiana Jones vs. the Epic Failures. What are the safety procedures to protect kids with allergies?

Peer Feedback
Stay engaged. Don't assume students will remember, even after reviewing. Ask questions as they work. And remember to discuss in the end or have each group present out their end results.

Chapter 2

Ajay Kalra: Rate of change and Linear equations

Hello, I am Ajay Kalra, Math educator and facilitator. I have been involved in the field of Math education continuously for 16 years as a Math Educator. I have been teaching /facilitating math courses ranging from pre-algebra level to advanced calculus level at High schools/Community colleges/Universities. I also had an opportunity to teach college algebra to US Marines stations in the U.S. embassy in New Delhi. I did my Master's degree in Mathematics from prestigious school (University of Delhi) in New Delhi. I did my math teaching certification program from National Louis University in Chicago and completed Masters of Online Teaching (MOT) from University of Illinois (Urbana).

Rate of change and Linear equations

Grade Level: 9-10
Content Area Topic: Slope
Content Area Standard(s): 8.EE.B.5,
Learning Objective(s):

- Determine the slope of a line given two points on it.
- Determine the slope of a line given its graph.
- Compare the slopes of two lines.
- Graphically by viewing the steepness
- Algebraically by viewing the slope values

Suggested Time Allotment: Three– 55–minute lessons

Sequence in Learning: After this lesson students will apply Common Core Mathematical Practices to slope, rates, unit rates, linear equations, and linear graphs. Students will also see how the concept of slope can be connected to real world applications.

Materials & Resources Needed:
Dry Erase Boards / Pens; Calculator; Colored pencils; Rope/string; Worksheets; Vocabulary Cards; Vocabulary Report; GeoBoards Practice; Geoboards Exit Ticket; Geoboards Homework; Slopin' It Up Warm– up; Coordinate Grid Transparency; Four Corners Activity – Slopes; Four Corners Activity – Graphs; Steppin' It Up Homework; Warm-up (lesson 3); Scavenger Hunt; Scavenger Hunt Student Record Sheet; Slope Application; Slope Quiz

Lesson Activities & Sequence:
Pre assessment: Students were given vocabulary cards (based on slope) and instructed to find another student(s) with same vocabulary word and together discuss how the word relates to slope. After a brief student discussion, each vocabulary group reported out to class. The students completed the "Vocabulary Report" chart as each group presents.

Setting the stage: Based on student input from the vocabulary card activity, I gave my students definition of the slope which students were required to copy on their vocabulary sheet the word, the definition and examples for slope.

I used Geo-board activity to demonstrate a positive slope. I used three different colored pens to correspond to rise, run and line to define the slope so that students could easily visualize what is rise and run to define measure of steepness which is called slope.

Student activities:
Geo-board (dot paper) activity: Students will use Geo-board sheet to develop the concept of positive slope with a positive "rise" and positive "run." The line formed by looping the beginning point and end point with colored pen would be the line that has the particular slope value. Lines with negative slopes, zero slope, and no slope will also be developed using colored pencils on Geo-board practice sheet

Four corners Activity: "Four Corners Activity – Slope" in four separate corners of the room"
In this activity, I cut up the graphs with different slops and give each student one graph and have them determine the slope of the line. Students were instructed to go to the corner of the room where the slope of their line is posted. Students discussed the similarities and differences amongst the graphs and the corresponding slopes.
.
Technology: Students used free online application to find the slope of line by changing the direction of line and moving points on lines.

Proficiency: Formative Assessment: Students are assessed during the lesson based on their classroom performances. These assessments are completed through teacher observations, peer questioning, and group work during the activities.

I used different tools and teaching strategies like proceduralization, paired learner model, modeling and experimentation and game completion with graduated difficulty to meet needs of different learning styles in class to understand and master the concept of slope.

Students were able to find slopes graphically and algebraically and also participated actively in Jeopardy game and four corner activity. Students communicated their understanding of concept using graph, formula and words. Without calculating slope of line student were able to recognize whether slope would be positive , negative, zero or undefined .Ability to recognize sign of slope of line will help them to recognize increasing and decreasing functions in subsequent topics in Algebra .

Summative Assessment: Students will be given check point quizzes, performance task and tests after the lesson to provide students an opportunity to communicate their understanding of concepts and skills through verbalization, visualization and symbolization.

Feedback

Teachers As Learners:
"Excited, good pacing, very visual, saw that we were advanced and moved quicker. Liked the way he assessed prior knowledge through words and visual. Did not allow student heckling to derail lesson. Good connection with students. Friendly affect"

My reflection:
Using pre-assessment and asking relevant question I got feedback about my students prior knowledge about concepts of slope .Most of my students did not know the meaning of slope (that it is measure of steepness and represents "unit rate of change".

I launched the lesson explaining student how to measure steepness using hands on activity on Geo- board emphasizing what is positive rise /run , what is negative rise and run, why horizontal has zero slope and slope of vertical line is undefined. I showed them video and images of from real life showing four different kinds of slope (positive, negative, zero, undefined).

Elements of Pretty Good Practice:
"Assessing prior knowledge was a great practice, had visual aids that students could use during the activity. Got us to move around, clear instructions on the handout, allowed to work in pairs. Good summary and review of objectives. Students were able to decide whether they met the objectives. Showing the visuals made the concept more real."

Modifications and Adaptations
I"Extending to more problems or real world examples. Could easily go to science pulley and levers. Kids could graph the slope of them walking or running. Use geoboards, higher level users could use a computer program. Use maps and ask what the slope of Clybourne, Montrose Hill, slide outside the playground. Go find different things in the neighborhood, what alphabetical letters have slopes? Skateboarding"

Questions Arisen by Group:
How could we make this more real world?

I have attached the power point presentation to show the real life application of concept of slope.

Affect of Teachers and Students:
Teacher was very excited, good pacing, very visual, saw that we were advanced and moved quicker. Liked the way he assessed prior

knowledge through words and visual. Ajay did not allow student heckling to derail lesson. Good connection with students. Friendly affect

Lens 2: Best Practices
Assessing prior knowledge was a great practice, had visual aids that students could use during the activity. Got us to move around, clear instructions on the handout, allowed to work in pairs. Good summary and review of objectives. Students were able to decide whethey we met the objectives. Showing the visuals made the concept more real

Lens 3: Standards
CSSS 8.E.E.B.5 Understanding expressions and equations.

Lens 4: Extensions and Adaptations
Extending to more problems or real world examples. Could easily go to science pulley and levers. Kids could graph the slope of them walking or running. Use geoboards, higher level users could use a computer program. Use maps and ask what the slope of Clybourne, Montrose Hill, slide outside the playground. Go find different things in the neighborhood, what alphabetical letters have slopes? Skateboarding.

Lens 5: Questions
How could we make this more real world?

Related Resources/Ideas
- Real Life Slope Application (PPT)
- Handouts
- http://www.nsa.gov/academia/_files/collected_learning/high_school
- http://www.montgomeryschoolsmd.org/departments/itv/mathdude/MD_Algebra1_3-1.s tm
- http://video.mit.edu/watch/slope-8183/

Chapter 3

Alicia Song: Solving problems: Save Fred!

My name is Alicia Song, I being a teacher for 23 years. I enjoyed working with the Latino community, because I identify with many of my students. I'm a bilingual teacher born in Mexico. I came as an immigrant when I was 15 years old. One of my most important tasks as a teacher is to inspire my students to think in new ways.

I believe a classroom is any place were opportunities for learning are constructed by the teacher. As educators, we have the ability to empower students to be thinkers and problem solvers. I'm the proud mom of a son and a daughter. During the summer I enjoyed gardening and walking close to nature. I have a bachelor's degree from University of Illinois at Chicago and a Master's Degree in School Leadership from Concordia University.

Solving problems: Save Fred!

Grade Level: 5th, 6th or 7thth grades
Content Area Topic: Experimental design
Content Area Standard(s):

- MS-ETS1-1. Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.
- MS-ETS1-2. Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.

Science and Engineering Practices

- Asking questions and defining problems: Ask questions so to arise from careful observation of phenomena, models, or unexpected results, to clarify and/or seek additional information.
- To define a design problem that can be solved through the development of an object, tool, process or system and includes multiple criteria and constraints, including scientific knowledge that may limit possible solution

Learning Objective(s):

- Students will recognize and analyze alternative explanations and predictions
- Students communicate procedures and explanations
- Students recognize different kinds of questions suggest different kinds of explanations
- Students will understand that scientists test their explanations using observations and experiments

Suggested Time Allotment: 60-minute session

Sequence in Learning:

This activity serves as an introduction to problem solving as a series of steps or elements that are present in every scientific investigation. Students in this activity examine the steps involved in problem solving by solving a simple physical problem. The idea is that students connect and learn that there are various approaches to scientific problem solving. In subsequent lessons examples of real scientists and methods will be observed. Students will have a better understanding of how scientist solve problems, and be able to correlate how our own processes relate to scientific processes. Students will be prepared to work with various models of the scientific method. Students will be able to recognize the

core elements of the scientific method. Students will be prepared to set up problems so they can be solved using a consistent methodology.

Materials & Resources Needed:
For each pair of students you will need: 1 gummy candy life preserver; 1 gummy candy worm; 1 plastic cup; 4 paper clips

Technology resources:
Available on website

Lesson Activities & Sequence:
Grouping: Pairs. The problem can be solved only between two students, more or less than two students can be frustrating and defeat the objective of the lesson.
Time: one 60 min session

- Set up the power point presentation, it will allow you to deliver the lesson from beginning to end.
- Provide students with handout for this activity. The first step is to elicit students' ideas about scientific design and pose questions such as- how do you solve problems? What kinds of problems do scientists work to solve? Have you learned about any of the methods scientists use to solve problems? Are these methods similar to the ones you use to solve problems?
- In their handout students will answer anticipation guide questions 1 & 2 before exposing them to the problem they're about to solve.
- Pose the scenario for students on how we are constantly solving problems and ask them- what problem you had to solve in the past week?
- Introduce the problem – How to save Fred. You can access the prezzi and communicate the challenge for student.
- Distribute materials for each pair of students- cup, gummy worm and gummy lifesaver as well as four paperclips.
- As students are working to solve the problem each pair of students should record observations about their problem solving approach on their handout. They have the choice to do this in words or illustrations.
- As students complete the task, have them switch the procedure they came up with and have a different pair of students try following the procedure.
- Students will probably encounter problems in solving each other procedures which can give you the opportunity to discuss how important it is to communicate clearly in words or illustrations, and how scientists replicate investigations from others to come up with own conclusions.
- You can present them with the scientific method and ask - If they

solved the problem following these steps, if so in which order? Students may have difficulty identifying each of the elements of the scientific method, so it might be necessary to discuss when they were making a hypothesis, following a procedure, collecting data and drawing conclusions.

- Show students three other ways in which you can solve a problem and ask them to identify which of these ways did they use to save Fred.
- Ask is they save Fred following this order and if they think scientists solve problems in this order.
- Ask students if they think scientists follow only one method to solve problems.
- Have students complete the anticipation guide one more type and revisit their preconceptions about solving problems. Allow them to write a reflection if they agree or disagree and why?

Proficiency:
When students have met the expectations for this objective they are able to compare their problem solving method with other problem-solving methods and conclude how scientists solve problems. Students will meet expectations of this objective when they are able to verbalize and identify the different elements of problem solving.
They will also be able to apply different problem-solving models to new problems and understand that is not the sequence in which you solve problems that is important but that the elements of problem solving model such as hypothesis, procedure, data collecting, analysis of data and drawing conclusions are represented.

Feedback

Teachers As Learners:
Students are challenged when they need to compare their own method of solving problems with different scientific models that are used by scientists today. This activity is a great starter to help students think about a scientific method and process when solving a scientific problem: it also forces students to communicate and listen carefully to one another as they compromise their suggestions and step procedures into one solution for the problem. Supporting documents and Power Points were smooth are useful. Transitions went well with drawing and/or writing procedures.

Elements of Pretty Good Practice:

- Think/Pair /Share, Anticipation guide, Hypothesize, Scientific method approach, Problem Solving, Prediction
- Hands-on activity was very good experience using the problem

solving task.

- The challenge was given at the beginning
- Established a purpose at the beginning
- Presenting a challenge by using Prezi.
- Learning was summarized at the end to tie everything together from the lesson.
- Time and duration was given
- Directions for trials was given prior to the experiment
- Relate the experiment to real-life coast guard rescue missions

Modifications and Adaptations

- Take the problem solving steps of the scientific method and have students organize steps without labeling the step number on them as presented in power-point
- Include modifications for diverse learners-some students may need to understand what each of the steps of the scientific method mean in order to understand when they were doing what (visual representation).
- Include what were the methods from solving your problem in a form of discussion
- Prior to performing the experiment have students draw up their own procedures and switch with another group.

Questions Arisen

- Are students able to visualize what scientists' processes are when solving problems? Technology can be used to record student data for the experiment, particularly quantitative data
- What problem do they have to solve? What procedure and plan they must follow to rescue someone?

Peer Feedback:

Colleagues suggested incorporating the use of technology to collect data specifically qualitatively. For this experiment though the collection of data is more of a writing a procedure or process of solving a problem. Students can also swap procedures and try to solve the problem from someone else's methods. It was suggested to link this activity to real-life rescue missions and to research on how rescuers solve situational problems. Students may watch interviews of National Guard as well as examining how scientists do clinical studies of people to solve problems.

Chapter 4

Ashley Keine: Zoo Design Project

I graduated from Michigan State University with a Bachelor's Degree in Elementary Education in 2009. I have been teaching second grade for five years in the Hyde Park neighborhood on the south side of Chicago. I am also the technology coordinator and am on the Instructional Leadership Team for my school.

Zoo Design Project

Grade Level: 2nd Grade
Content Area Topic: Math: Perimeter and Area
Content Area Standard(s):

- CCSS.MATH.CONTENT.3.MD.C.5.A: Recognize area as an attribute of plane figures and understand concepts of area measurement. A square with side length 1 unit, called "a unit square," is said to have "one square unit" of area, and can be used to measure area.
- CCSS.MATH.CONTENT.3.MD.D.8: Solve real world and mathematical problems involving perimeters of polygons, including finding the perimeter given the side lengths, finding an unknown side length, and exhibiting rectangles with the same perimeter and different areas or with the same area and different perimeters.

Learning Objective(s):

- Students will be able to construct a closed area with the needs of their animal in mind
- Students will be able to find the perimeter and area of the space they constructed

Suggested Time Allotment: 1 hour, 15 minutes

Sequence in Learning:
Background knowledge: Students have self-selected an animal to research through our unit on animals. In this animal unit, students have studied: Kinds of animals (mammal, reptile, amphibians, insects); Animal habitats; Animal diet; Animal adaptations and behaviors. Students have had a series of lessons around perimeter and area. We will be taking a trip to the Lincoln Park zoo in 2 weeks

Next Steps after this lesson:

- Students will draw/add elements into their captivity space that meets the needs of their animal.
- Students will write a paper about their designed space for their animal including reasons behind the design and elements that would be included in the animal's captivity space.
- A class zoo map will be constructed out of all student work. Consideration will be used in organizing where animals should be placed within the zoo.
- Students will take a trip to the Lincoln Park Zoo to compare their designed space with the space observed in the zoo.
- Students will finish this project with a writing piece explaining what they noticed in comparison between the two spaces.

Materials & Resources Needed:
Smartboard, Student research material, Student tablet, Student activity sheet

Student website for animal research:
http://kids.sandiegozoo.org/animals/zoo-animals

Lincoln Park Zoo Map:

Virtual graph paper:
http://www.garrettbartley.com/graphpaper.html

Student Activity Sheet:
On website

More resources for this lesson can be found at:
http://www.ashleykeine.com/stem-materials.html

Lesson Activities & Sequence:
Anticipatory Set: Teacher will present this lesson by talk about real world application of what we have been learning about it math. Teacher will ask students to turn and talk about a job in the world that could use the skill of finding the area and perimeter of a particular

space. Student responses will be collected and briefly discussed as a class. Teacher will then introduce the concept of someone designing the layout of a zoo, (if not already discussed in student responses).

Teacher Demonstration - Questions:

- Are all animal spaces in the zoo the same? Why not?
- Would an elephant and a spider need the same size, type of space? Why or why not?
- What do you need to consider when designing a space for your animal? (record student responses)
-

Teacher will then demonstrate an example of creating a space for a penguin

Teacher will then demonstrate how to find the perimeter and area (showing work) of the space created.

Student Independent Work:

- Students will organize their information from their research on their animal including animal habitat, diet, behaviors, etc.
- Students will use a tablet to design a space for the animal considering their research using the virtual graphing paper: http://www.garrettbartley.com/graphpaper.html
- Students will find the perimeter and area of their space they created

Proficiency:

Assessment: Rubric for self-assessment which includes:

- Did I correctly identify the area of my space using units?
- Did I show my work on how I go the perimeter of my space?
- Did I correctly identify the perimeter of my scape using units?
- Does my space accommodate my animal's needs?

** Perimeter and area calculations must be 100% correct in order to be successful in next lessons. If students are struggling, allow time for peer edit/discussion or conferencing with teacher. If spaces are created that are disproportionate to animal's needs, this will be corrected in future lessons.

Feedback

Teachers As Learners:

Teachers enjoyed this engaging lesson. It was crucial for them to know the position this lesson plays in the entire scope and sequence of the unit. The background knowledge was presented to them before the lesson began. Teachers liked the anticipatory set because it got their minds thinking in the lens of area and perimeter and applying it to real-world situations. Teachers were eager to work with the technology

provided as the teacher modeled what they would be doing. There was a learning curve with the technology and using the virtual graph paper. Questions arose about erasing a line and how to change the size of the grid on the graph paper. These questions were easily addressed and did not affect the learning. Teachers enjoyed using the technology and came up with very different designs for their animal spaces. They were able to explain their design features as it pertained to their animal's needs. Overall, the lesson had high engagement, was highly integrated with other content areas and challenged the teachers as learners to apply their knowledge to a real-world situation.

Elements of Pretty Good Practice:
This lesson included many different teaching and learning styles. The lesson began with an engaging discussion to get students thinking about real-world application of perimeter and area. Transitions from each section of the lesson were well-designed and seamless. The teacher modeled an example of the activity, allowing students to see the procedural steps and thinking behind the activity. The lesson incorporated hands-on technology using tablets that allowed students to easily play around with different designs without having to worry about erasing pencil marks and ruining their paper. The lesson incorporates science and social studies content while applying mathematics skills, giving students a well-rounded experience. Students had a very structured environment as they moved from one part of the lesson to the other. Students also were supplied a rubric for self-assessment, allowing students to take more ownership of their learning. The real-world application of this lesson drove everything. The lesson has been set-up nicely with previous lesson being taught and further lessons give this application real-world meaning for students.

Modifications and Adaptations
- To help reinforce that perimeter is a length for those students who are struggling, allow students to use a geoboard with a piece of string to create a space. Then have students measure the piece of string as a single line.
- For struggling students, allow them to use attribute blocks when designing their space so they can spatially see where elements would go to accommodate their animal's needs.
- For advance students, allow them to show their work for area not by counting but by using strategies of multiplication.
- Allow students to share their designed zoo space with an employee at the zoo. This would be a great ending the unit that shows a true real-world application of content.

Questions Arisen

- How do I erase a line on the virtual graph paper? Press the undo button in the control box located in the lower right corner
- How do I change the size of the grid on the virtual graph paper? Click the scale button in the control box located in the lower right corner to change the grid size
- Can you use this virtual graph paper on any device? Yes, it is an online website, therefore as long as your device can access the Internet, you can use the virtual graph paper.
- What does the self-assessment time look like? Students use a rubric to help assess their space. Students may also pair up to help correct any miscalculations on the area and perimeter.

Peer Feedback:

- This lesson could easily be adapted to higher-grade levels. Ideas that were suggested are:
- Scale factor lesson using higher mathematics applications
- Creating a house blueprint then constructing a model
- Creating a playground design

Chapter 5

Chrissy Garcia: Investigating Introduced Species

Chrissy Garcia is a middle school science and literacy teacher in the Chicago Public School system. Chrissy strives to provide students with engaging and enriching learning opportunities because all children deserve a quality education. Chrissy is a proud alumna of Chicago Public Schools, University of Illinois Urbana-Champaign, and the Golden Apple Scholars of Illinois program.

Investigating Introduced Species, sneak peak of Ecology Argumentative Writing Unit

Grade Level: Seventh Grade
Content Area Topic: Science and Language Arts

Content Area Standard(s):
Common Core Math Standards
- MP.6-8.1: Make sense of problems and persevere solving them..
- MP.6-8.5 Use appropriate tools strategically.

Common Core Reading Standards
- RST.6-8.1: Cite specific textual evidence to support analysis of science and technical texts.
- RST.6-8.2: Determine central ideas or conclusions of a text; provide an accurate summary of the text distinct form prior knowledge and opinions.
- RST.6-8.7: Integrate quantitative or technical information expressed in word in a text with a version of that information expressed visually (e.g.; in a flowchart, diagram, model, graph, or table).
- RST.6-8.8: Distinguish among facts, reasoned judgment based on research findings, and speculation in a text.

Common Core Writing Standards
- WHST.6-8.1: Write arguments focused on discipline-specific content.
- WHST.6-8.4: Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.
- WHST.6-8.5: With some guidance and support from peers and adults, develop and strengthen writing as needed by planning, revising, editing, rewriting, or typing, a new approach, focusing on how well purpose and audience have been addressed.
- WHST.6-8.6: Use technology, including the Internet, to produce and publish writing and present the relationships between information and ideas clearly and efficiently
- WHST.6-8.8: Gather relevant information from multiple print and digital resources, using search terms effectively; assess the credibility and accuracy of each source; and quote or paraphrase the data and conclusions of other while avoiding plagiarism and following a standard format of citation.
- WHST.6-8.9: Draw evidence from informational texts to support analysis and reflection, and research.
-

Common Core Speaking Standards

- SL.1: Prepare for and participate effectively in a range of conversations and collaboration with diverse partners, building on others' ideas and expressing their own clearly and persuasively.
- SL.2: Integrate and evaluate information presented in diverse media and formats, including visually, quantitatively, and orally.
- SL.4: Present information, findings, and supporting evidence such that listeners can follow the line of reasoning and the organization, development, and style are appropriate to task, purpose, and audience.

Next Generation Science Standards

- MS-LS2-1: In any ecosystem, organisms and populations with similar requirements for food, water, oxygen, or other resources may compete with each other for limited resources, access to which consequently constrains their growth and reproduction.
- MS-LS2-2: Similarly, predatory interactions may reduce the number of organisms or eliminate whole populations of organisms. Mutually beneficial interactions, in contrast, may become so interdependent that each organism requires the other for survival. Although the species involved in these competitive, predatory, and mutually beneficial interactions vary across ecosystems, the patterns of interactions of organisms with their environments, both living and nonliving, are shared.
- MS-LS2-1: Growth of organisms and population increases are limited by access to resources.
- MS-LS2-4: Ecosystems are dynamic in nature; their characteristics can vary over time. Disruptions to any physical or biological component of an ecosystem can lead to shifts in all its populations.

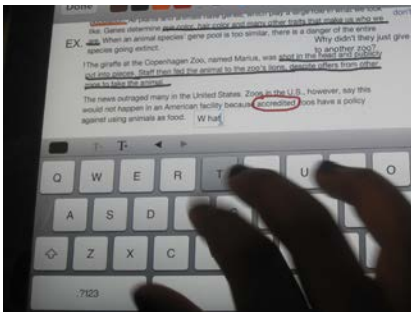
Learning Objective(s):

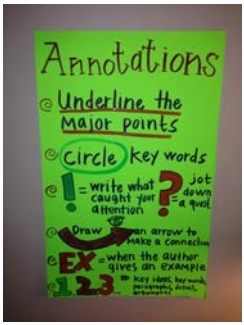
- Obtain, evaluate, and communicate information about the consequences of introducing a species to another ecosystem
- Engage in argument from evidence to debate the advantages and disadvantages of introducing a new species to an ecosystem
- Engage in argument from evidence to debate the advantages and disadvantages of whether or not there should be laws in place to regulate exotic pet ownership
- Research relevant information from multiple print and digital resources to support claim
- Engage in conversation roundtable to build on classmates' ideas and clearly articulate their own ideas
- Define a problem about how humans can impact an ecosystem

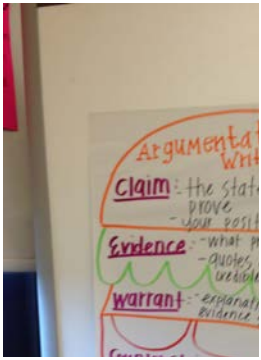
Suggested Time Allotment: 45 minutes for lesson
Minimum of 4 weeks for the unit

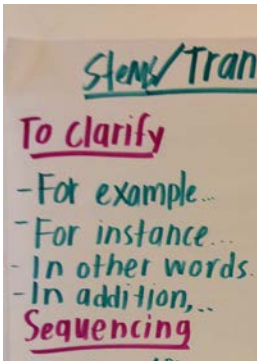
Sequence in Learning:
Prior to completing this lesson, students will have begun investigating ecology. Students will have already collaboratively close read the following texts: "Exotic Pets Gone Wild: Tegu Lizard Wreaks Havoc in the Florida Everglades" and "Pet turns pest: California kingsnakes rampage across the Canary Islands" in whole group, small group, and independent practice. The texts are available from NEWSELA. Articles can be printed at five different lexile levels to support students with diverse reading levels.

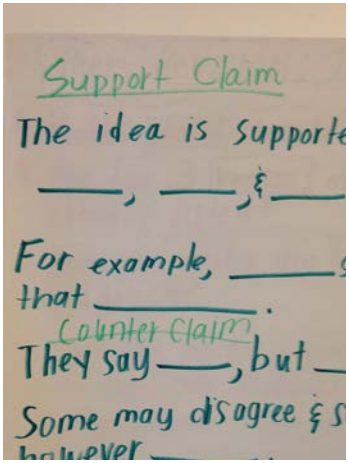
Students will do multiple reads of the text to make connections to predator and prey relationships, food chains and food webs, limiting factors of population, ecological disruptions, human impact, and control of invasive species. The goal of the science argumentative writing unit is to engage in argument from evidence to debate the advantages and disadvantages of introducing a new species to an ecosystem and to debate whether or not there should be laws in place to regulate exotic pet ownership.

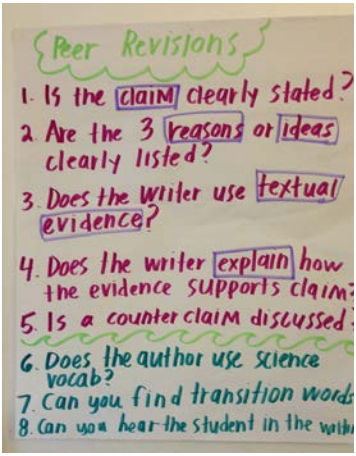












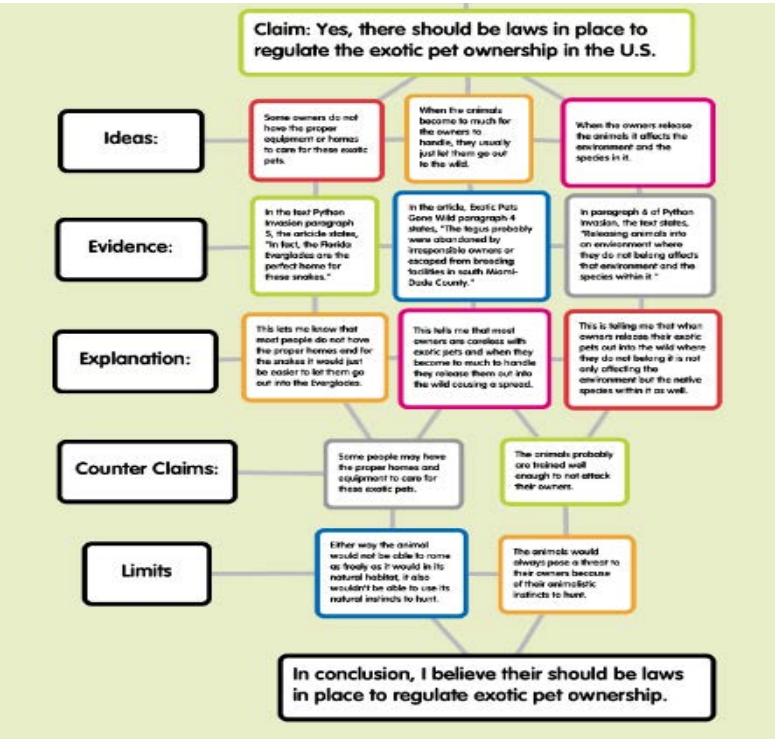


Figure 1. Students annotate using EduCreations
Figure 2. Annotations anchor chart
Figure 3. Steps of argumentative writing
Figure 4. Sentence stems for diverse learners
Figure 5. Discussion questions for student led revisions
Figure 6. Stems to state claim and counter claim
Figure 7. Student created outline using Popplet Lite

Materials & Resources Needed:

- Printed Articles: (any of the following) --- https://newsela.com/?needle=invasive+species
- Exotic pets gone wild: Tegu lizard wreak havoc on Florida's ecosystem --- https://newsela.com/articles/environment-tegulizard/id/1335/
- A Beautiful by deadly predator stalks the Gulf of Mexico -- https://newsela.com/articles/invasive-lionfish/id/4288/
- Pet turns pest: California king snakes rampage across the Canary Islands --- https://newsela.com/articles/kingsnake-canaryislands/id/3774/

- Anchor Charts; Annotations Symbols; Argumentative Writing Steps; Sentence Stems; Transitions; Peer Revision Conversation Guide

Video Clips:

- The Python Problem http://www.pbs.org/wnet/nature/lessons/the-python-problem/video-segments/5699/
- Biological Invaders http://illinois.pbslearningmedia.org/resource/tdc02.sci.life.eco.bioinvaders/biological-invaders/

- Documentary: Elephant in the Living Room http://theelephantinthelivingroom.com/

- Technology: iPads/ computers; Mind Mapping applications (Popplet Lite/Mindmeister); Annotating applications (Educreations); Socrative.com or Socrative application

- Rubrics: Conversation Roundtable; Annotations; Argumentative Writing

Science Argumentative Writing Conferences/Assessment:
Student's Name: _____ Date: _____

What I did well	Areas to further develop	Feed-back notes

Used precise language and content-specific vocabulary Used correct sentence structure Used appropriate punctuation Introduced claim and supporting ideas Maintained a formal style Used appropriate and varied transition words/ Used textual evidence to support claim Conclusion included synthesis Produced clear and coherent writing appropriate for the task, audience, and purpose	Used precise language and content-specific vocabulary Used correct sentence structure Used appropriate punctuation Introduced claim and supporting ideas Maintained a formal style Used appropriate and varied transition words/ Used textual evidence to support claim Conclusion included synthesis Produced clear and coherent writing appropriate for the task, audience, and purpose	

Laminated accountable talk stems:

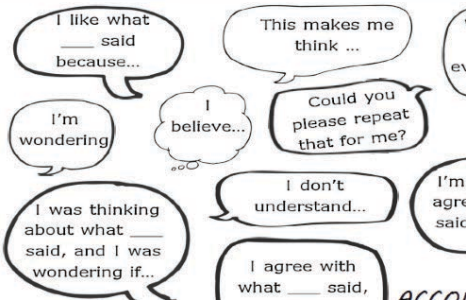


Figure 8. http://www.teacherspayteachers.com/Product/Accountable-Talk-Stems-and-Expectations-955548

Lesson Activities & Sequence:
Anticipatory Set: Pre-assessment journal question: How can an introduced species impact an ecosystem?
Think: The question should be preloaded to socrative.com. Students access the prompt via Socrative app or website by typing in the class code to respond to the journal question.

Before answering the prompt, identify key vocabulary words essential to understand what it is asking. Students should highlight the

words introduced species and ecosystem. Use word analysis to break down the word ecosystem. Do we notice any important word parts? Eco- What other words include this word part? Ecology, ecologist, etc. Based on our understanding of the word part eco- what does the word ecosystem probably mean?

Pair: Students will turn to an elbow partner to share their response to the question. (2 minute)

Share: Students will discuss their partner's ideas during a whole group share.

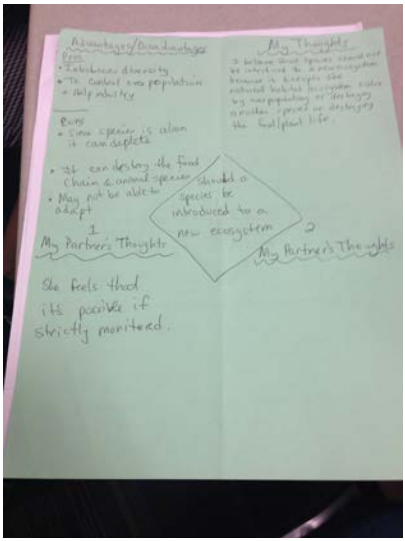
I Do: Create a web of concepts that related to introduced species to activate prior knowledge.

Explain that as we have read or science articles, we have learned that there are advantages and disadvantages of introducing a new species to an ecosystem. Introduce the strategy conversation roundtable. Conversation roundtable allows students to collaboratively discuss a thought question, actively listen and comment on ideas that have been stated, and apply their understanding of course concepts.

Using a four square graphic organizer similar to the one below, students will respond to the prompt: Should a species be introduced to a new ecosystem? This will require us to use evidence from the text, video clips, and our prior knowledge to engage in an argument with our peers.

We Do: Students will be given 5 minutes to generate as list of the advantages and disadvantages of introducing a species into a new ecosystem using the top left square of their graphic organizer. When the timer buzzes, students will partner with an elbow partner to share their list of advantages and disadvantages in a three minute period. Any idea that is discussed that is not already listed in the student's graphic organizer will be added to the first box (shown above). The class will return to whole group to record their ideas on a class anchor chart.

In the second box on the top left, students will be given five minutes to independently respond to the prompt using their own ideas and evidence from the text.



*If students do not have experience with conversation roundtable, model how to use the accountable talk stems and discussion.

You Do With Partner: With a second thinking partner, students will use accountable talk stems to discuss their ideas for 4 minutes. Students will record their partner's claim, key points, and/or evidence to support their claim. Students will rotate to interact with a third partner and repeat steps to complete the fourth box on the conversation roundtable graphic organizer.

Closing Discuss the process of conversation roundtable in whole group. Ask Reflection question: What did you and your partner do well? What did you and your partner struggle with? How can you make changes to improve your dialogue later? What did the class look like while you were dialoguing with your peers? What did the classroom sound like? What skills must we integrate to effectively engage in conversation roundtable?

Exit Ticket: Respond to the same bell ringer prompt on Socrative. Download excel spread sheet with the data and compare bell ringer and exit ticket responses.

Proficiency:
What does it "look like" when students have met expectations for this objective? How will you evaluate it?

Elements	1	2	3
Key Ideas	Few key ideas with textual support or analysis.	Some key ideas included with some textual support and analysis.	Major key ideas are included with textual support and analysis.
Participation	Limited participation in the discussion.	Some participation in discussion.	Active participation in discussion.
	Does not try to add to the discussion.	Adds 1-2 ideas to the discussion.	Adds 3+ ideas to discussion.
	Off task conversations.	Sometimes has off task conversations	Uses accountable talk stems to enhance conversation.
Graphic organizer	Graphic organizer is incomplete.	Some of the boxes are accurately complete.	All boxes are completed accurately.
	Summary of partners' responses is incomplete.	Includes brief summary of partners' responses.	Includes detailed summary of partners' responses.

Feedback

Teachers As Learners:

The lesson maximizes instructional time by using the timer. Students were constantly engaged in discussion and had limited opportunities to be off task. The teacher must be conscious of diverse learners and should provide appropriate scaffolding as need. The teacher made informal observations of discussions, modeled an academic conversation by joining the discussion while using the accountable talk stems, and prompted students with extensions to continue the dialogue.

Elements of Pretty Good Practice:

The lesson was integrated, which included reading, writing, communication, and science to explore the ecological issue of introduced species. There is evidence of formal and informal assessments such as bell ringer pre-assessments, conversation roundtable graphic organizers, and post-assessment exit tickets. Using Socrative as a discussion format allowed students to safely communicate their thoughts and showed the teacher their current understanding of the topic. The use of the graphic organizer provides students with a way to structure and organize thoughts. Providing students will flexible grouping promoted positive student-to-student discourse and respect while exposing students to different viewpoints.

Modifications and Adaptations

- Integrate cross-disciplinary vocabulary strategies. Include Frayer models, vocabulary journals, vocabulary mapping, non-linguistic representations of vocabulary words, and clearly post vocabulary words on chart paper or the board.
- Provide pre-made a conversation roundtable graphic organizer to students with special needs such as IEPs and EL support.
- Provide materials in native languages for ELLs.
- Provide students with a peer scribe, digital version of the graphic organizer, or offer video commentary for students with fine motor deficits and/or limited English proficiency.

Questions Arisen

- How can mathematics be integrated into instruction?
- What tech resources can enhance the lesson?
- How will students be assessed formally and informally throughout the unit?

Peer Feedback

Overall, the lesson supports science, English language arts, and communication standards providing students with rich opportunities to critically think, problem solve, discuss, and obtain and analyze information about ecology concepts.

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Chapter 6

Donna Calder: Marble's At Work

I am a science teacher in Chicago Public Schools. I have been teaching for 9 years and it has been a very challenging and rewarding experience. In the laboratory, students engage in hands-on activities that help them better understand the world around them. Students become scientists through exploration, questioning, and experimentation. I continue to be a learner by participating in quality professional development that helps me master my craft. As the world changes, so does our approach to teaching. It is crucial to stay current and creative to engage students in problem-solving techniques like questioning new situations by applying acquired knowledge. Children are naturally inquisitive so critical thinking skills are practiced as the student's work through problems. I encourage students to look at their world through a different lens and think about what they see.

Marble's At Work

Grade Level: 4-8
Content Area Topic: Science(Energy)
Content Area Standard(s):

- MS-PS3-1 - Construct and interpret graphical displays of data to describe the relationships of kinetic energy to the mass of an object and to the speed of an object.
- MS-PS3-2 - Develop a model to describe that when the arrangement of objects interacting at a distance changes, different amounts of potential energy are stored in the system.

Learning Objective(s):

- Learn how potential energy transforms to kinetic energy
- Be able to explain work in a scientific context
- Manipulate variables and test hypotheses

S*uggested Time Allotment:* 45 minutes

Sequence in Learning:
Students have received an introduction to energy. Energy can take on many different forms (e.g. thermal, sound, mechanical, etc.), but it can neither be created nor destroyed. Most forms of energy are a type of kinetic or potential energy. Kinetic energy, or moving energy, is the energy something has because of its motion—the energy a marble has when it is rolling on the floor. Potential energy is the energy that comes from the position of one object relative to the position of another—the energy a marble has when it is being held at the top of a ramp. In a scientific context, we do work when we apply force on a object and that object moves in the direction of the force you exert on it. For instance, when you push a marble and roll it across the floor, you are doing work which equals the change in kinetic energy of the marble—the marble moves!

Below is the formula for gravitational potential energy (in joules), where m is the mass of an object in kilograms, g is the acceleration due to gravity (9.8m/s2), and h is the height of the object above the surface:

Gravitational potential energy = mgh

The amount of gravitational potential energy an object has depends on its mass, and its height above the Earth's surface—the greater the height and the mass, the more gravitational potential energy the object has.

The kinetic energy of an object depends on the mass of an object (m) and its velocity (v):

$$Kinetic\ Energy = 1/2\ mv^2$$

The greater the object's mass and velocity, the more kinetic energy it has. Students will understand that mechanical energy allows objects to do work, which is a way of transferring energy from one place or form to another. Through these activities, students will realize that mechanical energy is all around them.

Materials & Resources Needed: (Per Group)
A couple of thick books ; 3 marbles; 1 ruler (ramp); 1 paper or Styrofoam cup; cut in half lengthwise; Tape; Stopwatch; Vocabulary List; Worksheet (click here for the student worksheet)

Lesson Activities & Sequence:
WARM UP 5 minutes
Ask students if they can define what the word work means. Students will likely come up with definitions that correspond to the everyday use of the word work - "I worked really hard on that project" or "my parents went to work today". Explain that the definition of the word work in the context of science is different: in science, work is when we use a force to move an object. Give students a few seconds to think about this while you write the definition on the board. Now push really hard to move an object that won't move (like a wall). Ask students if you did work. If they say yes, point to the definition on the board and ask if the wall moved. Now take a pencil and push it so that it rolls across a table. Did you do work that time? Explain that energy was transferred from you to the pencil. The pencil got kinetic energy — energy of motion — from you and moved: you did work!

Students will prepare for group work and check poster for job assignments for that month. Groups of four at each table have assigned animals based off of classification. Students will determine what job they are responsible for based off the poster. For example a picture of a bat will look for the mammal assignment for that month. It could be the leader, getter, recorder, or the clean machine (each job is defined in a poster that has already been established in class).

Leader runs the activities/Getter retrieves all supplies/recorder completes activity sheet and reports out/ clean machine times the activity and cleans and puts materials back in proper locations.

*Part I Explore 3 minute*s
Place one of the half cups on its side on a smooth, level surface, so that it makes a cave with an opening on one side.

Take turns to roll a marble into the open end of the cup, and observe what happens when…
… the marble hits the back of the cup
… the marble is rolled at different speeds
… the marble is rolled from different distances of the cup

Part II: Height 5 minutes
Stack 3 books on a level surface (a desk or the floor). Lean the ruler on the books so it makes a ramp. The ruler should be placed so that the lower numbers are at the base of the ramp. Fix the ruler in place with tape so it will not move from one experiment to the next
Place a half cup at the base of the ramp so that a marble rolling down the ramp will enter the cup and push it.
Position one marble at the top of the ruler (30 cm) and let it go.
How far did the cup move? Measure from the base of the ramp to where the cup came to rest. (NOTE: the cup may be at an angle to the ramp, so measure from a line that crosses the midpoint of the cup edge—see image on the next page)
Repeat the experiment 2 more times, so that you will have 3 measurements. Average your 3 measurements.
Now release the marble from 3/4 of the way up the ramp (at 22.5cm), halfway up the ramp (15 cm), and 1/4 of the way up the ramp (7.5 cm). Be sure to release the marble three times from each position on the ramp, and calculate an average.
Record all your measurements on the Student Worksheet table.

Part III: Mass 5 minutes
Repeat the experiment above releasing 2 marbles together, instead of just 1. Place the marbles one behind the other on the ruler, making sure that the lead marble is at the correct spot on the ramp (i.e. 30, 22.5, 15, and 7.5 cm).
Record all your measurements on the Student Worksheet table.

Part IV: Velocity 5 minutes
Take away the cup from the ramp setup.
Measure a distance of 1 meter from the base of the ramp. Mark that distance with tape.
Use a stopwatch to time how long it takes for a marble to go from the base of the ramp to the 1-meter mark. Release the marble from the top (30cm), 3/4 of the way up (22.5 cm), half way up (15 cm), and 1/4 of the way up (7.5 cm). Make sure that you repeat the experiment 3 times at each ramp height.
Record all your measurements on the Student Worksheet table.
Calculate the average time of all three trials.

Proficiency: 10 minutes

- Exit slip is completed worksheet. Student groups that complete 80% of the worksheet meet the level of success.
- Some possible misconceptions:
- Objects that are dropped do not have motion energy. For example, a dropped object doesn't have motion energy because gravity is just pulling it down.
- Energy is associated mainly with human beings, not inanimate objects.
- A lighter object has more motion energy than a heavier object because lighter objects move faster than heavier objects.
- A lighter object has more motion energy than a heavier object because lighter objects move faster than heavier object.

Additionally, students should complete the following task:
5 minutes Each group will have to report by answering two of the five questions

- Which marble has the most kinetic energy—one moving fast or one moving slowly? The one moving fast has the most kinetic energy.
- How did you measure the amount of energy a rolling marble has? By measuring how far the marble(s) pushed the cup or measuring how long it took the marble to reach the one meter mark.
- How did the height from which the marble was released on the ramp affect how much the cup moved? The cup moves a longer distance when the marble is released from a higher point
- How did the number of marbles (mass) released from the ramp affect how much the cup moved? The more marbles we used, the cup moved a longer distance.
- Which marble moves faster (has the greatest velocity) - one released from the top of the ramp, or one released from the middle of the ramp? The marble that is released from the top of the ramp.

Feedback

Teachers As Learners

- I really like the sequence of these investigations.
- After every part, bring it back together whole group, journal, etc. allowing students to connect it back to energy. Helps adjust for misconceptions. Usually time is a restraint so maybe I could break into two lessons.
- Kids need that prompting to figure out what are they doing with these marbles. As the groups are working the teacher is facilitating by visiting each group and probing with questions regarding the vocabulary related to energy.
- I often forget when doing big inquiry lessons, that you need to bring

it back together, so that kids don't get carried away. Very important to time activities and circulate around the classroom to keep students on task.

Elements of Pretty Good Practice:
Guided Inquiry allows students to question and test building knowledge to what they already know. Hands-on gives student to exposure of doing. Collaboration provides students opportunity to teach and learn through their peers.

Modifications and Adaptations
I also like the idea of having a community space to write/post summaries of each section. This is excellent. I will create this space for the beginning of year.
I wonder if you use a spring so you can exert the accurate amount of force for each trial run, to reduce the amount of error. Differentiated Instruction:)
Screen shot Worksheets and add a summary box on the sheet after each part

Questions Arisen
How does this relate to energy? Why don't we stop at each part to make sure students understand each part of inquiry? What is gravitational potential energy?

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Chapter 7

Bellasanta Ferrer: In a (functional) relationship?

Bellasanta Ferrer,, a native of the Philippines, has lived in Chicago, Illinois since 2001. A former geologist, Bellasanta has been a middle school science teacher at Haines Elementary in Chinatown, Chicago since 2012. Bellasanta received her B.S. in Geology from the University of the Philippines. As part of the AUSL's first cohort, she earned her MAT in Elementary Education, with middle school endorsements in mathematics, general science, and physical science, from National Louis University in 2003. This year, 2014, Bellasanta is in the first cohort of the MSU-WIPRO Urban STEM & Leadership Fellowship program.

In a (functional) relationship? (aka Relationship between perimeter & area)

Grade Level: 6th-grade (middle school)
Content Area Topic: Perimeter and area, a non-constant relationship
Content Area Standard(s):

- CC6.EE Expressions and Equations 9. Represent and analyze quantitative relationships between dependent and independent variables
- CC6.G Geometry 1. Solve real-world and mathematical problems involving area, surface area, and volume.

Mathematical Practices

- Make sense of problems and persevere in solving them
- Reason abstractly and quantitatively
- Construct viable arguments and critique the reasoning of others
- Model with mathematics
- Use appropriate tools strategically
- Attend to precision

Learning Objective(s):

- To form at most 4 different shapes with the same perimeter using string or pipe cleaner
- To estimate area (square cm) of the shapes while attending to precision
- To describe relationship between a shape's area and a constant perimeter (explicitly, quantitatively, and concretely)
- To construct viable arguments for the dog area shape proposal and to critique the reasoning of others

Suggested Time Allotment: Two 45-minute sessions or one 90-minute block

Sequence in Learning:
Requisite lessons:

- Investigating the relationship between the perimeter and area of squares that increase in side lengths by one centimeter unit. This investigation is part of the algebra unit on algebraic thinking and functions including multiple representations of functions i.e. in a context, a table of paired values, as a formula, and as linear and non-linear graphs.
- Estimating perimeter and area of an irregular shape, their own palm. The estimating strategies here can be used for the next lesson.

Requisite knowledge/CCSS Math

A. Measurement and Data

- Measure and estimate lengths in standard units: Measure the length of an object by selecting and using appropriate tools i.e. rulers, yardsticks, meter sticks, & measuring tapes
- Geometric measurement: Understand concepts of area and relate area to multiplication and to addition; Recognize perimeter as an attribute of plane figures and distinguish between linear and area measures.

B. Geometry

- Classify two-dimensional figures into categories based on their properties: Understand that attributes belonging to a category of two-dimensional figures also belong to all subcategories of that category (e.g. all rectangles have 4 right angles and squares are rectangles, so all squares have 4 right angles and vice versa)

Subsequent lesson:

Optimal fenced-in rectangular brick patio (a landscaping design project proposal simulation). This follow-up real-world design project aims to provide students the opportunity to apply the concepts of perimeter and area and their non-constant relationship. Students will create or design a fenced-in rectangular brick patio as specified by a client of a landscaping company. This experience will not only contribute to a general understanding of the relationship between shape, size, and economics but will also extend students' earlier work on pattern variation in the perimeter and area of rectangles. This experience will likewise lay a foundation for a further examination of surface area in geometry and calculus.

Materials & Resources Needed:

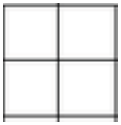
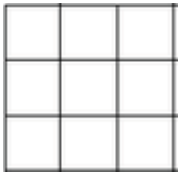
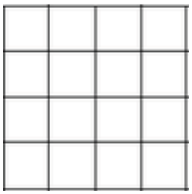
Each group needs: 48-cm string or pipe cleaners, ruler, scissors, grid paper (with 10mm or 20mm primary grid and 2mm sub-increment grid http://customgraph.com/samples/customgraph-engineering.pdf), data table or spreadsheet on paper or online (student-made or provided by teacher)

Lesson Activities & Sequence:

Activation of Prior Knowledge: (10-15 minutes)

1. Review previous investigation (Growing Squares) on the relationship between perimeter and area of squares that increased in side lengths by 1 cm

- Review generalizations based on this investigation (students can explain in words, algebraically, physically, and/or visually)
- The perimeter of a square ...
- The area of a square…

Illustrated or actual tiled squares	Side length (cm)	Perimeter (cm)	Area (square cm or cm2)
	1	4	1
	2	8	4
	3	12	9
	4	16	16
	5	20	25
	n	4n	n^2

2. Review strategies used to estimate area of students' own palm

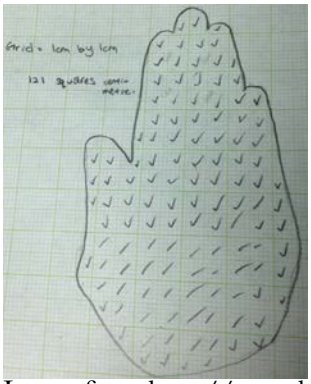


Image from http://rongshanphysics.wordpress.com/

3. Launch of investigation/challenge: In a relationship?

- What does it mean when someone is in a relationship like in FB?
- What could it mean when something is in a relationship (like dependent and independent variables?
- Connect back to the previous lesson that modeled the relationship between perimeter and the side length of a square and the relationship between the square's area and its side length.

Challenge: Today, your team will help solve the problem of two people in a relationship. They have a garden that they want to use for an enclosed play area for their dog, for growing herbs, and for outdoor entertainment. They want you to suggest the best shape that will enclose the most space for their dog's play area using their 12-meter fencing material.

You have 10-15 minutes to plan and create your shapes and use the area estimation strategies from yesterday's lesson to find the area of your shapes. Record your work on paper (student- or teacher-made) or electronically. Each team will present and argue in favor of the proposed dog play area. Be ready to look for what each team did well and to critique each others' reasoning. Any questions?

Group students according to self-perceived level of understanding of the two previous lessons on the perimeter and area of the growing squares and palm area estimation.

Review team members' job or responsibility (materials manager, group facilitator/time keeper, spokesperson, recorder/procedure captain)

Each group can decide which materials/technology to use: a) string or the pipe cleaner, b) grid paper (with 10mm or 20mm primary grid and 2mm sub-increment grid), c) paper or online data table or spreadsheet, d) student-made or teacher-made data table, e) to present their team's proposal, and f) provide feedback and critique

Proficiency:
The rubric below will be given in advance and used for team self-assessment.

	Incomplete &/or incorrect	One section Complete but missing	Complete & correct	Above & beyond
Shapes	less than 4 shapes	4 shapes but	4 different shapes with same perimeter	+systematic increase in area
Area	incorrect or incomplete estimates	estimates area but	appropriately estimates area of all 4 shapes	+explains precision options
Area & perimeter relationship	incomplete or unclear description P/A non-constant relationship	completely describes P/A non-constant relationship but...	clearly/ correctly describes the non-constant P/A relationship	+describes relationship in 3 different ways
evidence-based argument or proposal	incomplete or unclear proposal	presents proposal for fenced-in dog area but...	completely & correctly argues for proposed fenced-in dog area based on evidence	+uses appropriate technology, data, or observations as evidence to compliment & critique the proposal of other teams
Team work	some members were off-task for parts of the challenge	members perform roles but...	members perform roles as expected	+members model team & individual accountability

Best shape for enclosed dog play area

Shape	Perimeter (cm or mm)	Area (square cm or square mm)

Feedback

Teachers As Learners:

- Availability of different materials to use, paper, or physical objects, or computation to explore different shapes and find its area
- Some were confused over whether the area that was being created was for the dog only or to include the other two, herb garden and outdoor entertainment space. One way to avoid this confusion would be to start with just the dog play area then add the other spaces as an extension of the main lesson.
- Intentional grouping, scaffold visual or ESL learners by providing pictures (dog, garden) and screenshot of FB. Including a screenshot of the "in a relationship" status page in Facebook might help students make the connection to the lesson title and the Facebook social media.
- Lesson could be easy to adapt to different grade levels, abilities, and learning modalities including being an English language learner.
- Activated prior knowledge
- Allowed students to choose the materials to use in their exploration and design
- Had students present and critique each others' process and proposal to the class.

Elements of Pretty Good Practice:

- Reviewed previous lessons to assess and activate prior knowledge
- Different students had a choice on what materials to use and how to use them. The pipe cleaner allowed students to recreate their shapes as needed to correct 'mistakes.' The other groups loved how the multi-grid graph paper facilitated the estimation of the shapes' area.
- Teacher moved between groups, answering questions, observing
- Allowing students to group according to prior knowledge
- Teacher expectations laid out through use of rubric
- Students evaluated each other's work rather than by the teacher

Modifications and Adaptations

- Extend this lesson by providing more complex problems such as: Redesign of school classroom or school garden.
- Students were given graph paper with 10mm or 20mm primary grid and 2mm sub-increment grid
- Include connecting cubes manipulatives
- Students design their own questions and give them to others
- Students can create shapes with specific lengths/widths so they can relate to the previous lesson on squares with changing side lengths
- Data can also be plotted in a length versus area graph for another representation

Questions Arisen

Content: Was the proposal about finding the dog play space with the most area using the 12-meter fencing materials or to include the other two spaces, herb garden and outdoor entertainment?

Pedagogical approach: Alternative questions can be designed for using all three areas. You can rephrase questions to assess different ideas.

- How to group? Intentionality?
- How would the use of technology change how the lesson is delivered?

Technology: Are there applications to draw figures and calculate areas?

- Does the use of technology, i.e. Geogebra, allow for more inquiry and argumentative discourse?

Peer Feedback

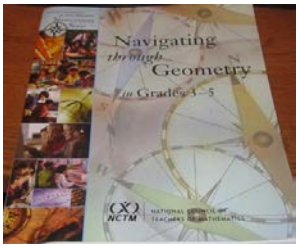
They suggested to stay in teacher mode throughout the teaching demo session. They prefer that no explanations of the teacher's pedagogy are given while the demo is ongoing.

Bibliography:

- Ferrer, B., Hunter, B., Irwin, K., Sheldon, M., Thompson, C., and Vistro-Yu, C. (2001). By the Unit or Square Unit? Mathematics Teaching in the Middle School. National Council of Teachers of Mathematics (NCTM). 7, 132-137
- Gavin, K., Belkin, P., Spinelli, A., and St. Marie, J. (2001), Navigating through Geometry in Grades 3-5. National Council of Teachers of Mathematics.
- Nichols, E., et al. (1985), Holt Mathematics-Grade 7. New York: Holt, Rinehart & Winston.

Related Resources/Ideas

Facebook relationship status screenshot,



Chapter 8

Jen Lewin: Henrietta Lacks and the Importance of Medical Ethics

Jen Lewin is a middle school teacher in the Chicago Public Schools. She works at John C. Coonley Elementary in the North Center neighborhood. I love my job. I work with some of the most talented students in the city and am a forever student myself. I quite possibly learn more from them than they do from me.You might see me riding about town on my scooter (meep meep), on my bike getting coffee, or lollygaggin at the dog park with a couple of furry nerds. When I›m not learning more about my discipline I enjoy art and checking out concerts. Camping is a must for me. Having lived here for almost two decades, I will never tire of the endless culinary options here in the windy city. I hear the architecture is «pretty good» too. I have a Bachelors of Science in Biology from Loyola University Chicago and a Masters of Education from DePaul University Chicago.

Henrietta Lacks and the Importance of Medical Ethics

Grade Level: 7th Grade
Content Area Topic: Biology
Content Area Standard(s):
- All living things are composed of microscopic units called cells (LS1.A)
- New technologies increase some risks and decrease others. Some of the same technologies that have improved the length and quality of life for many people have also brought new risks (ETS2.B)
- Disease is a breakdown in structures and functions of organisms (LS1.A)
- Diseases can be caused by the environment, genes, viruses, and lifestyle (LS1.A)
- Mutations can be helpful, harmful, or neutral in how they affect an organism
- Technologies having to do with food production, sanitation, and health care have dramatically changed how people live and work and have resulted in rapid increases in the human population (ETS2.B)

Learning Objective(s):
- To analyze the importance of medical ethics in cell analysis
- To explore how citizen science can help contribute to medical breakthroughs
- To research various forms of cancer
- To identify misconceptions related to cancer cells and normal cells
- To compare and contrast different forms of cancer in the female reproductive system

Possible Misconceptions:
- All cancer comes from the same type of cell
- The difference between malignant and benign cells
- Cells are two dimensional
- Certain characteristics are always inherited by the mother and some by the father
- Different cell types contain different DNA

Suggested Time Allotment: 2-3 Class periods (at least 60 min each)

Sequence in Learning:
This lesson can be taught during the Cell Biology unit recommended by the Chicago Public Schools Department of Science. Although I use the Lab-Aids SEPUP Curriculum, this lesson is intended to supplement the lessons where students study the germ theory of

disease, cell structure and function, and how human research is conducted. Genetics can be incorporated before or after the unit.

Requisite Knowledge

- Student knowledge of microscopy and cell parts, how people are studied
- Teacher knowledge of histology (see resources), HIPAA (see resources)

Materials & Resources Needed:

- https://www.zooniverse.org/project/cellslider
- The Immortal Life of Henrietta Lacks by Rebecca Skloot
- Malignant Cell Tissue Set from Carolina Biological
- Computer access
- Data sheets (attached)

Lesson Activities & Sequence:

Engage:

- Teacher will read the section of prologue from The Immortal Life of Henrietta Lacks where the author talks about seeing pictures of the cells for the first time (p. 2, starting at the first full paragraph to the last full paragraph on p. 5)
- Students will discuss why Rebecca Skloot's biology instructor chose to use the HeLa cells as a model for mitosis, why the HeLa cells were so important to the advancement of science, and Rebecca Skloot's mission to study the affect on Henrietta's family.
- Students will read Chapter 6 where Rebecca Skloot attempts to contact the family about Henrietta's cells.
- Teacher will share with students a recent news article about development in the HeLa cell saga (NIH web link), emphasizing how long it took for the NIH to come to an agreement about how the family's wishes would be taken into consideration when continuing research with the cells
- Students will take part in a class discussion of what life was like during the time where Henrietta Lacks was getting treatment

Explore

- tudents will read about how cervical cancer grows (p. 28 from the first full paragraph to p. 33 end)
- Students will discuss how the cancer is categorized and how doctors prepared to take excise the cancer
- Students will discuss the "consent" that Henrietta signed
- Students will view the various cancer cell samples from the malignant slides set
- Students will focus on cancers of the female reproductive system,

making comparisons between the different types of cells
- Students will practice using Cell Slider

Explain:
- Teacher will walk students through Cell Slider tutorial
- Students will discuss how citizen science can help diagnose cancer cells while simultaneously respecting patient privacy
- Students will reflect about how the cells they viewed are similar/ different to the cells on cell slider

Elaborate:
- Students will share their experiences about using cell slider

Evaluate:
- Students will research ovarian and breast cancer. Using their research and knowledge from the activity, they will create a project from the choice board (see supporting documents).

Differentiation:
- Use of graphic organizers to assist with lab journaling give students prompts to work on labs more independently, provide a visual space or organization and note-taking, provide
- Use of computer interactives for learners of various levels
- Varying levels of questioning to assess students across a variety of learning styles

Proficiency:
- Rubric for final choice project under "Evaluate" in 5E lesson (see attached)
- Data sheets to assess group work and understanding
- Students should walk away knowing that science benefitted in many way from Henrietta's misfortune. As a society, it is our obligation to recognize that injustice and make sure we do not repeat those same mistakes.

The priority for the lesson and assessment should lie with:

Cell Structure, Medical Ethics, Medical Research Techniques, Citizen Science Tools for Research Advancement

Feedback

Teachers As Learners:
- Lesson was authentic (using real malignant cell samples, use of personal biography representing injustice, teacher created) and engaging (had the group's attention from the start)

- Bringing literature into the lesson was a great hook (used Henrietta Lacks biography)
- Powerful way to discuss several controversial topics (racism, women's & civil rights, patient privacy rights) in a meaningful lesson

Elements of Pretty Good Practice:
- Beginning of lesson … using a real life story was a great launch for the lesson. The level of engagement was maintained throughout the lesson
- Exploratory – use of online cell slider (citizen science, computer modeling)

Modifications and Adaptations:
- Include graphic organizer for student to complete during lesson
- Include prompt for student reflections to capture student discussion during the lesson
- Find additional websites to learn more about cells, cancer research, etc.
- Connect to study of related careers

Questions Arisen:
- Do students have their own computers when doing this lesson?

Bibliography:

- Skloot, R. (2010). The Immortal Life of Henrietta Lacks. New York, NY: Crown.

Related Resources/Ideas:
- http://rebeccaskloot.com/the-immortal-life/teaching/ (resources from the author's website)
- http://www.hhs.gov/ocr/privacy/ (background on HIPAA)
- http://www.histology-world.com/contents/contents.htm (background on histology)
- http://htwins.net/scale/ (micro to macro scale interactive)

Pathologist Name:_____ Date Sample Analyzed:_____

Purpose:

- To analyze the importance of medical ethics in cell analysis
- To explore how citizen science can help contribute to medical breakthroughs
- To research various forms of cancer
- To identify misconceptions related to cancer cells and normal cells
- To compare and contrast different forms of cancer in the female reproductive system

Malignant cell observations (focus on female reproductive system slides, but you are welcome to observe the other cell slides if you finish early):

Draw and describe what you are seeing on each slide, taking care to label and diagram each drawing.

* There actually are 4 text blocks but have been removed for this book

Are there any cell parts you have studied that you can identify?

ZOONIVERSE
REAL SCIENCE ONLINE

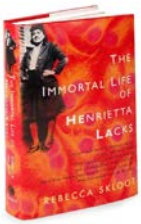
Cell Slider Interactive:

- Did you find it easy or difficult to identify the cell types in each example? Explain your answer.
- Why is this research valuable and how does the citizen science project assist this research?

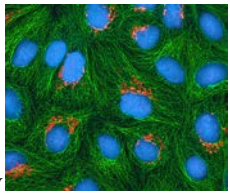
Discussion

- What were some of the similarities and differences you and your group observed between the cells you were asked to identify in Cell Slider? Create a t-chart below to highlight some key factors.

- Were the slides you observed in the lab similar or different to what you observed in Cell Slider? Explain.
- What would be important skills for a doctor and a pathologist to have in order to properly diagnose cancer cells?
- What scientific tools or technology allow us to diagnose malignant cells?



Henrietta Lacks and Her Living Legacy



- What are some key issues that were identified when discussing Henrietta's tissue samples?
- Was Henrietta respected as an individual? List key factors that support your ideas.
- Imagine that you or a family member were faced with a similar situation. How might you react? Would you have concerns? Would you want your cells used for research? What sort of privacy would you expect from the doctor or hospital?
- How has Henrietta's case shaped how medicine works today?

Choice Board for Public Awareness Campaign

 Grant proposal for research (i.e. genetic, cancer, better technology)	 Write a politician	 Documentary about a patient's life
 Public Service Announcement	Your goal is to raise awareness about patient rights and disease research. Choose one of the following project ideas that you feel you could use to send the best message. Use the rubric to verify you have included all components for a quality project.	 Fundraiser proposal (walk-a- thon, bake sale)
 News segment on the local news	 Pamphlet for doctors' offices to provide patient information	 Create your own idea! This should be detailed as the other project ideas are and approved by me. Come up with a proposal about how you would spread the word.

Public Awareness Campaign : Using the Past to Inform the Future
Teacher Name: Lewin
Student Name:

CATEGORY	4	3	2	1
Research/ Statistical Data	Students include 4 or more high-quality examples or pieces of data to support their campaign.	Students include at least 3 high-quality examples or pieces of data to support their campaign.	Students include at least 2 high-quality examples or pieces of data to support their campaign.	Fewer than 2 high-quality examples or pieces of data to support their campaign.
Campaign/ Product	Students create an original, accurate and interesting product that adequately addresses the issue.	Students create an accurate product that adequately addresses the issue.	Students create an accurate product but it does not adequately address the issue.	The product is not accurate.
Internet Usage	Successfully uses suggested internet links to find information and navigates within these sites easily without assistance.	Usually able to use suggested internet links to find information and navigates within these sites easily without assistance.	Occasionally able to use suggested internet links to find information and navigates within these sites easily without assistance.	Needs assistance or supervision to use suggested internet links and/or to navigate within these sites.
Scientific Concepts	Report illustrates an accurate and thorough understanding of scientific concepts underlying the project.	Report illustrates an accurate understanding of most scientific concepts underlying the project.	Report illustrates a limited understanding of scientific concepts underlying the project.	Report illustrates inaccurate understanding of scientific concepts underlying the project.
Sources of Information	All sources (information and graphics) are accurately documented in the desired format.	All sources (information and graphics) are accurately documented, but a few are not in the desired format.	All sources (information and graphics) are accurately documented, but many are not in the desired format.	Some sources are not accurately documented.

Chapter 9

Joanna F. Doyle: Creating Main Characters

Joanna Doyle is passionate about helping students and teachers become technology creators, not just consumers. To this end, she is always on the lookout for new opportunities to play with technology (she is currently a Google Glass Explorer) and has brought many programs to her school including Codecademy, Gamestar Mechanic, and SimCityEDU. As one of the first CPS teachers to use iPads in the classroom, she developed an integrated curriculum that brought her to the attention of an education technology company. After working with them as the Director of Instructional Innovation and Learning Design and partnering with districts to launch blended learning programs across the country, she is proud to return to Chicago Public Schools. She thrives on professional collaboration, so catch her presenting at a conference or get in touch with her through twitter @joannafdoyle or the Google+ community: plus.google.com/+JoannaDoyle. She would love to hear your ideas!

Creating Main Characters

Grade Level: 1st grade
Content Area Topic: Language Arts
Content Area Standard(s):

- CCSS.ELA-Literacy.RL.1.3 Describe characters, settings, and major events in a story, using key details.
- CCSS.ELA-Literacy.W.1.3 Write narratives in which they recount two or more appropriately sequenced events, include some details regarding what happened, use temporal words to signal event order, and provide some sense of closure.
- CCSS.ELA-Literacy.W.1.5 With guidance and support from adults, focus on a topic, respond to questions and suggestions from peers, and add details to strengthen writing as needed.
- CCSS.ELA-Literacy.W.1.7 Participate in shared research and writing projects (e.g., explore a number of "how-to" books on a given topic and use them to write a sequence of instructions).

NETS for Students

- Creativity and Innovation
- Students demonstrate creative thinking, construct knowledge, and develop innovative products and processes using technology.
- Create original works as a means of personal or group expression
- Communication and Collaboration Students use digital media and environments to communicate and work collaboratively, including at a distance, to support individual learning and contribute to the learning of others.
- Interact, collaborate, and publish with peers, experts, or others employing a variety of digital environments and media

Learning Objective(s):

- Students will identify the main character in a novel.
- Students will create a main character as a class as part of a shared writing project.
- Students will create their own main characters.
- As a result of this lesson, students will know that interesting main characters that readers care about make a story fun to read. They will be able to create a description of their main character for their novel.

Suggested Time Allotment: 90 minute literacy block

Sequence in Learning:
"Creating Main Characters" is the third lesson in the unit "What Makes a Story Worth Reading?" Students have already identified what makes a fictional book and good book that is fun to read and what

makes a book seem boring. One of the characteristics of a good book is that it has interesting characters that you care about. Good books also use descriptive words to paint a picture in the readers mind. In this lesson, students will participate in a shared writing activity where they create a main character as a class and then create descriptions of their own main characters in their writing journals. Students are actively engaged in the experience because they are working towards publishing their own novels as part of NaNoWriMoYWP (National Novel Writing Month Young Writers Program) and will be sharing their published novels with the school, their parents, and the wider community through digital publishing. They will also go on to make an animated film adaptation of their novels using the Toontastic app.

Materials & Resources Needed:
Large sheets of paper to create shared writing character description and post it as an anchor chart (such as post-it self-stick easel paper); Student Writing Journals; Class Conference Form (for the teacher)
iPads with Google Drive Word Wall, shared document to list books and main characters, and projector to project this list on the board
Markers, Crayons, and/or colored pencils; Books that you have read together in class and that are at various reading levels appropriate to the class (to use to help students identify main characters they have already read about) (can use the same books from "Great Books, Gross Books" lesson); Gonoodle.com for brain break; Three Ring app for creating digital portfolios; NaNoWriMo class site and resources http://ywp.nanowrimo.org/

Lesson Activities & Sequence:
Adapted from NaNoWriMo Young Writers Program

Step One: All About You 5 minutes
- Have students talk about themselves. Ask them the following questions:
- What do you look like?

- What do you do for fun?
- Where do you live, and what is it like there?
- What annoys you the most?
- Go through each question as a class and ask students to answer using as many details as possible. Call on a few students for each question or have students turn and talk to a partner for 30 seconds each.

Step Two: Introduce Main Characters 10 minutes

- Say, "Today, we are going to begin creating characters for our novels. Just like you and me, characters in books have likes and dislikes, homes, friends, and family. They have things they love to do in their free time and things that make them wish they were getting their teeth pulled instead."
- Project the list of books (in the shared Google Doc) you have read as a class (from the "Great Book, Gross Book" lesson plan) at the front of the room, making sure it is visible to all students.
- Say, "Let's go down the list and name the most important character in each of these books. Who had the starring role? Who was the book all about?"
-
- Write these characters' names after the titles on the list. Say, "The most important character in a book—the character with the starring role—is called the main character. Novels are about a main character's adventure to make his or her dreams come true."

Step Three: Create a Main Character as a Class 10 minutes

- Hang two large sheets of butcher paper at the front of the room: one for jotting down character information, the other for drawing the character. Label the first piece of paper "Information about our main character."
- "Okay, first off, is our main character going to be a person or an animal?" Write the students' answer (reached by consensus) on the "Information" piece of butcher paper.
- "Is our character a boy or a girl?" Write the answer on the Information sheet.
- "How old is our character?" Write the answer on the Information sheet.
-
- On the second sheet of butcher paper, draw a visual of the main character you are creating.
- "What color hair does our main character have?" Draw the hair on your character.
- "Is there anything weird or unusual about our main character's appearance?" (An obvious scar? Three eyes? A unicorn horn? etc.) Draw these aspects on your character.

- "What is our character's favorite outfit? What is our main character wearing?" Draw the clothes on your character.
- 3. Once you have a visual, take a few moments to answer some extra questions about your main character. Write the answers to these questions on the Information sheet:
- Where does our main character live?
- What does our main character do for fun?
- What makes our main character happy after a bad day?
- Does our main character have any special skills or talents? Any super powers?

****BRAIN BREAK!!!! Project a gonoodle.com activity on the board and take a movement break! (5 minutes)****

Step Four: Students Create Their Own Main Characters 30 minutes

- Tell students they will be writing a description of their main character in their writing journals. They can choose to start with the written description or start by drawing a picture. Tell them their character must be different from the one created in class. Remind them to use as much detail as possible—What color is their main character's hair? What kind of clothes does he or she wear? Is he or she carrying anything? What is the expression on his or her face? etc. Students can write details around the pictures of their characters or can dictate information to an adult if needed. Students should also be encouraged to use the word wall and add helpful words to the word wall to help the whole class with spelling and vocabulary.
- As students are working, hold individual conferences with students that are struggling or pull a small group for extra support.

****BRAIN BREAK!!!! Project a gonoodle.com activity on the board and take a movement break! (5 minutes)****

Step Five: Share 20 minutes

- Have students share their drawings and writing with the class. Students should also mention their main character's name and what kind of a creature he or she is (a person, an animal, a talking lampshade, etc.).
- Have students take pictures of their work with their iPads to add to their digital Three Ring portfolio.

Proficiency:

Student work will be assessed in partnership with the student during individual conferences throughout the lesson (and throughout the rest of the week, as needed). In the conferences, the students will explain their work to the instructor and explain why they feel it is a

good character description and will make the reader care about their character. During the conference, the teacher should be listening to identify what the student has done well, note it on the Class Conference Form, and celebrate with the student. The teacher should also look for one thing that the student could improve, teach a very brief skill lesson, and record the lesson and the goal on the Class Conference Form. The teacher will not write on the student work at this point in time or provide more than one teaching point as it is important for the students to feel that their work is valued and not overwhelm/ discourage them with too much revision (lessons about the revision process will come after students have finished their first draft). The teacher will, however ensure that the description is complete enough that a student will have enough information to move on in the novel writing process. This blog post has some additional tips and video examples for writing conferences.

Feedback

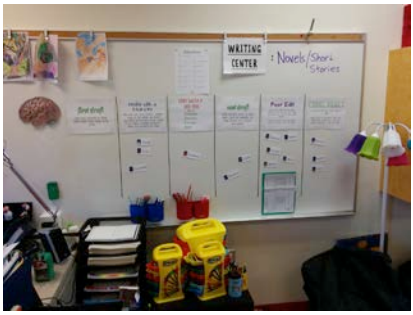
Elements of Pretty Good Practice:

- Writers Workshop Model
- This lesson follows the principles of Constructivism. Students will build on their pre-existing knowledge of what makes a book enjoyable to read and what makes a reader care about a main character and then go on to apply these characteristics to their own writing by creating a character description for the main character in their novels. The instructor will act as a facilitator and mentor to guide students in solving problems that they encounter and model some possible solutions, as needed.
- In order to provide and environment that maintains the "zone of proximal development" for all learners (pushing them enough so that they must stretch to learn new things but not so much that they become frustrated and shut down), this lesson follows a writer's workshop model. In this model, the instructor teaches a short minilesson that introduces a new concept and provides shared writing practice (no more than 10-15 minutes) and then the students independently apply what they have learned. During this independent work time, the instructor conferences with individual or small groups of students based on each individual student's need. During these conferences, the instructor starts by pointing out what the student(s) is doing well and then focuses on one additional teaching point (or reteaching a concept from a minilesson) to encourage the student to develop their writing skills.

Student Independence

- Students can track their progress through the writing process using

a chart in the writing center. This is also a place where they can independently get any materials they need:

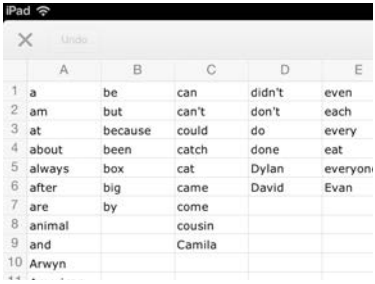


Peer Conferencing

Conferencing with peers as well as conferencing with the teacher helps students learn how to communicate about their work and provide feedback to peers in a respectful way.

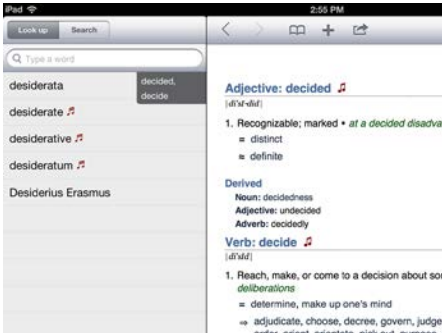
Scaffolding Spellling Support

- For young writers, not knowing how to spell a word can get in the way of their writing flow.
- Using a Collaborative Google Spreadsheet Word Wall allows students to add words that they don't know how to spell so they can find them again the next time they need them. It also introduces young students to the concept of using spreadsheets to organize information.



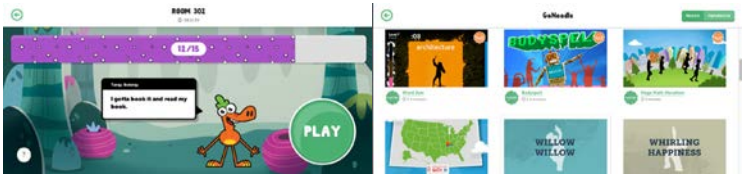
	A	B	C	D	E
1	a	be	can	didn't	even
2	am	but	can't	don't	each
3	at	because	could	do	every
4	about	been	catch	done	eat
5	always	box	cat	Dylan	everyon
6	after	big	came	David	Evan
7	are	by	come		
8	animal		cousin		
9	and		Camila		
10	Arwyn				

As students become more skilled stretching out words and identifying all of the phonemes, they can transition to a talking dictionary such as "Word Web" for spelling support. Students attempt to type the word and can click on the audio button (in this case, music notes) to hear the options read aloud.



Brain Breaks

Kids need to get up and move! By building movement breaks into the daily routine, students always know that they will get the chance to laugh and wiggle, something that is very important as you work towards building writing stamina and expect the students to write for longer periods of time. Websites like GoNoodle provide a variety of gamified brain breaks that are fun incentives for the students.



Modifications and Adaptations

- Students of any age benefit from writing as part of a Writer's Workshop. Nancy Atwell has published wonderful materials about working with middle school students using Writer's Workshop. The

National Novel Writing Month Young Writers Program website also has lesson plans that go from K-12.
- Students of any age need some time to move. This post includes some additional brain break resources.

Questions Arisen
- Is there a way to incorporate brain breaks that are related to the mini-lesson for the day?
- How could this lesson be modified for a shorter block of time?
- Are there any organizations that have youth programs for nonfiction writing?

Peer Feedback
My peers had a great idea to help students who may be struggling to develop a character or who may have limited fine motor skills. Students could use pictures of different physical character traits and combine them to create their character. Then they could write a description based on that picture, or in the case of limited fine motor skills, record an audio description.

Related Resources/Ideas
- National Novel Writing Month Young Writers Program
- Three Ring
- Google Drive
- Word Web Talking Dictionary
- GoNoodle

Chapter 10

Kenneth B. Freeman: Linear Tables, Graphs, & Equations – How Are The Connected?

Throughout my career, I've operated under the belief that creating sustainable success is best achieved through setting goals, executing action plans, and swiftly correcting problems in order to remain on target. During my 15-year career in the Information Technology field at AT&T and Motorola, I've utilized this approach to establish and maintain some of the most sophisticated technology environments within those organizations.

As a Mathematics, Science, & Technology Educator in the Chicago Public School (CPS) System, I've continued using a process-management approach toward building academic excellence among adolescents in predominantly low-income areas. Since joining CPS in 2002, I've provided instructional leadership, process management, & change control training to individuals and teams in the education field.

Linear Tables, Graphs, & Equations – How Are The Connected?

Grade Level(s): 7th - 8th
Content Area Topic: Mathematics
Content Area Standard(s):

- 7.EE.4 - Use variables to represent quantities in a real-world or mathematical problem, and construct simple equations and inequalities to solve problems by reasoning about the quantities.
- F.IF.4 - For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship.

Learning Objective(s):

- To use prior knowledge + current content learning to construct data table from an algebra problem situation that involve consistent (linear) change in distance and time.
- To use created table and create a graph of problem situation, comparing the information that a table can provide vs. what a graph provides.
- Using table and graph, and the guess-check method, to create a linear equation that can be used to calculate any distance location if he time is known, and vice-versa
- Decide which of the 3 methods is best used under certain conditions.

Suggested Time Allotment: 4 Sixty-Minute Class Periods

Sequence in Learning:
Before this lesson series, students have already had teaching and learning immersion on concepts such as proportional reasoning, the elements that makeup data tables (ex. Columns and rows), the elements that makeup a linear graph (x/y axis, data marker, coordinate pairs), etc..

Much less time in this lesson should be devoted to the creation of the table, and then graphic this data. Time emphasis should be placed on the creation of linear equations, and the important aspects of them, based upon the table and graphs. More time should also be devoted to exploring the relationship between these 3 analysis tools.

Looking ahead, student should be ready for more in-depth teaching and learning surrounding strategies for creating equations from tables and/or graphs, finding the slope (i.e. ratio of how distance and time

change in this problem). They should also be given practice on a battery of similar problems, with different types of variable values that change consistently. Following this, they can be taken through lessons on the different forms of linear equations: Slope-Intercept Form (which this lesson covers), Point-Slope Form, and Standard Form.

Materials & Resources Needed:
Math Notebooks/Journals For Note Taking (of new material) and Review (of prior lesson content); Graphing Paper; PowerPoint Presentation; Copies of Data Recording Sheets From Presentation
Calculators (optional)

Lesson Activities & Sequence:
LAUNCH (see accompanying PowerPoint presentation for reference)

- Inquire about students' prior knowledge (whole group)
- Have student write 2 or 3 specific things they already know about the topic (individually)
- Students' share-out unique knowledge they have with entire class. Repeated information from multiple students is discouraged for the sake for time.
- Teacher guides students through review of each method of analyzing an algebraic situation and the advantages/disadvantages of using Tables/Graphs/Equations. Students take notes in math notebooks as well as complete copies of table-style handouts
- Teacher gives formal definition of a linear algebraic situation, highlighting that for a situation to be linear, there must be 2 related things that change in a consistent manner.

EXPLORE (see accompanying PowerPoint presentation for reference)

- Teacher presents problem situation about a topic students are very familiar with; include in the problem names/places that majority of class already know about
- Students use notes/handouts to answer math reasoning questions about the problem, and construct a data table supports their answers. (individually)
- Teacher walks through the classroom to monitor table creations; questions any student(s) that misrepresents the changing time data between the two distance-changing data sets.
- Students then use the tables they created to construct 2 straight-line graphs (in the same plane) that represents the changing time/distance of the subjects in motion from the problem. (individually)
- Teacher spot-checks table creations, insuring that required elements are being included by students. Afterwards, students are put into groups of 3 or 4 to try and determine the linear equations that mimic the table and graph results.

SUMMARY (See powerpoint)

- Student groups are asked to share out the equations they came up with, explain how they got them, and to test their validity by calculating values from their tables or graphs.
- Students are asked to choose the method that worked best for them in this situation.
- Teacher probes to see if students can conclude that using the slope-intercept form equation is the most efficient way of solving algebraic problems of this nature.

Proficiency:

- Students will be able to read the algebraic problem statement, determine the changing data relationships (variables), and construct a data table. From this, they will be able to create a graph of this data and using the trial-error method, define an equation that can be used to re-construct the table or the graph.
-
- Evaluation of whether each student has met these objectives would be done via informal review of their work (as teacher walks through the room monitoring progress). Formal assessment of student mastery would be via assignment of the "Extend It" questions from the accompanying PowerPoint presentation.

Feedback

Teachers As Learners:

Group Feedback: Students feel heard and listened to very interactive lesson. Lots of questions were asked by students seeking help. As a student, I feel I had the opportunity to reflect. Good questioning techniques by the teacher. A lot of review options available to students prior to being given the problem to solve. Connection to prior knowledge and other content/science was present.

Teacher Response: Group had the most trouble creating the starting point for the table for each of the boys leaving the gym. At Time = 30 minutes, group had boys distance recorded based upon their travel rate. They failed to realize that after 30 minutes, Jalen had traveled some distance but Antonio had not yet moved. Since graphs and equation were based upon the table data, inaccurately recording table results would have lead group (and students) to constructing erroneous artifacts.

Elements of Pretty Good Practice:

Group Feedback: Access students' prior knowledge via having them write 1 or 2 things they already know about topic

Having students work alone on some tasks (used to assess individual understanding), with a partner (to see different ways of solving problem)
Having students work in groups on some tasks, which some may see as very helpful, and for purposes of creating a "shared thinking" environment for tasks that would take lots of time to do alone.

Modifications and Adaptations
In what ways can the lesson be changed to accommodate my personal teaching and learning contexts and/or learners? (List the feedback from your colleagues)

Group Feedback: Math Adaptations - Graphing and then compare in the class the differences.
L.A. Read for information to go over and underline key words and phrases.
Extend to real life when you rent movies at rate per hour or membership to gyms, clubs etc.

Questions Arisen
Use this to raise questions about the content, the pedagogical approach, the use of technology, or any other questions the group has about the design and delivery of the lesson.

Group Feedback: How do you differentiate this assignment based upon student's prior knowledge?

Peer Feedback: What suggestions did your colleagues share related to your teaching demo? None

Related Resources/Ideas: Power Point Presentation

Chapter 11

Beverly Keane: Mighty Magnets on the Move

My name is Beverly Keane. I am a Science Lab teacher in Chicago. I see myself as a curator of science experiences and a facilitator of constructivist learning projects. I am a life-long learner and am currently enrolled in the Michigan State University Wipro Urban STEM Fellowship Program. In this program I am learning about educational technology and pedagogical practices and theory, as well as science and math content. I am also learning how to utilize technology in the classroom in a meaningful way.

About me personally; my greatest gratification in life comes from being a proud mother of three and a grandmother of three marvelous grandchildren. I also like to travel, garden, bike, hike kayak, knit and read. I like to read classics & fiction and do not have a favorite book. My favorite movies are Forest Gump, Planes, Trains and Automobiles, and Quest for Fire.

Mighty Magnets on the Move

Grade Level: Primary – Grade 1
Content Area Topic: Physical Science
Content Area Standard(s):
Unit 2: Forces and Motion
From A Framework for K-12 Science Education- Chicago Pubic Schools Science and Engineering Practices; Disciplinary Core Ideas; Component Ideas

- PS2: Motion and Stability: Forces and Interactions
- PS2.A: Forces and Motion
- PS2.B: Types of Interactions
- PS2.C: Stability and Instability in Physical Systems
- PS3: Energy
- PS3.C: Relationship between Energy and Forces
- ETS1: Engineering Design
- ETS1.A: Defining and Delimiting an Engineering Problem
- ETS1.B: Developing Possible Solutions
- ETS1.C: Optimizing the Design Solution
- ETS2: Links among Engineering, Technology, Science, and Society
- ETS2.B: Influences of Engineering, Technology, and Science on

IL State Learning Standards Content Skills

- 12.D Know and apply concepts that describe force and motion and the principles that explain them.
- 12.D.1a Identify examples of motion.
- 12.D.1b Identify observable forces in nature.
- 11.A Know and apply the concepts, principles, and processes of scientific inquiry.
- 11.B Know and apply the concepts, principles, and practices of technological design.
- 13.A Know and apply accepted practices of science.
- 13.B Know and apply concepts that describe the interaction between science, technology, and society.

Unit 2: Forces and Motion

- Go to the CPS Knowledge Center (Curriculum/Instruction > Content Area Subpages > Science > CPS Science Content Framework) to access this document online

Learning Objective(s):
Students will be able to determine that a magnet can attract through other objects such as water and paper/cardboard based on evidence.

Forces and Motion: Knowledge Center (Curriculum/Instruction >

Content Area Subpages > Science > CPS Science Content Framework) to access this document

Key Ideas

- The motion of an object can be changed by forces (pushing or pulling). (PS2.A, PS2.C)
- Scientists sometimes learn about things around them by doing something to the things and observing what happens. (ETS1.A, ETS1.B)
- Scientists compare their observations with observations of others. (ETS1.C)

Crosscutting Concepts

- Asking questions (for science) and defining problems (for engineering)
- Developing and using models
- Planning and carrying out investigations
- Analyzing and interpreting data
- Using mathematics and computational thinking
- Constructing explanations (for science) and designing solutions (for engineering)
- Engaging in argument from evidence
- Obtaining, evaluating, and communicating information

Suggested Time Allotment: One Lab Period – 90 minutes

Sequence in Learning:

This lesson is part of a primary physics unit entitled "Science in the Toy Box" which was adapted from the Science Anytime series by Harcourt Brace. During this unit, students learn about force and motion. They learn that force is a push or a pull and that there are various forces such as the forces exerted by wind, water, gravity, etc. After studying each type of force, students make a toy that utilizes the force they were focusing on in that particular lab. When learning about force in general, students are introduced to magnetic force. They experiment with magnets and learn that magnets have both north and south poles. Students learn that a magnetic field exists within a magnet, but also extends beyond it. They learn that magnets have both a pulling force-attraction, and a pushing force called repel. In this lesson students investigate whether or not a magnet's force can also pass through other materials.

In a subsequent lesson, students will dig deeper into what magnets attract. They will learn that magnets attract some metals but not all metals. We dispel the common misconception that magnets attract all metals. To conclude our lessons on magnetic force, students will

learn that magnets attract to items containing iron, cobalt, steel, or nickel and it is related to electricity. Students then begin learning about electrical force.

Materials & Resources Needed:
Clear plastic cups – One for each student or if preferred one for each group of students; Water; Paper clips; Pre-made magnet sticks (hot glue a magnet to the end of a craft stick and then tape for extra security); Paper Plates; Car stickers, pre-made car copies, or have students make their own cars; Crayons or Markers

Lesson Activities & Sequence:
Grouping: Students sit in table groups of four students.

Introduction: 15 Minutes
I begin the lesson by connecting to prior knowledge about magnets. I ask the students to show me with their hands what attract looks like and the students clap their hands together and hold them together. Then they show me what repel looks like and they act out pushing their hands away from each other.

After this quick review, I tell the students that I have been thinking about a scientific question and ask the students if they will experiment to find the answer for me. I then ask them to make a hypothesis about whether or not magnetic forces will attract objects through other objects. I make a data table on the board to record each student's answer of yes or no. We then count the tallies and record the total number of each type of response.

Test # 1 Water - 30 minutes
I pass out a tray to each table. Each tray contains four plastic cups ¾ full of water, four paper clips, four paper towels, and four magnet sticks. Students are then directed to keep their cups in the tray, pick up a paper clip and drop it into the cup of water. They are then told to use their magnet's attractive force to test to see if they can pull the paper clips out of the water and the cup. The students then freely experiment to see how they can use the magnet stick outside of the cup to pull the paperclip to the top of the cup or go around the cup, etc.

After the students have finished experimenting and pulling their paper clips from the cup I ask the students if magnets can attract through water. They respond yes. We go back to our hypothesis data on the board and briefly discuss it. I tell students to dry off their paper clip with the paper towel and hold on to their paperclips and magnet sticks. I then collect all trays. We then move on to the paper plate test.

Test # 2 Paper Plate – 45 Minutes

Students are given a paper plate. Students are directed to place their paperclip on top of their paper plate and place their magnet stick underneath the paper plate. Students then experiment trying to move the paper clip around the plate using the attractive forces of the magnet. Students will determine that magnets can attract through paper or cardboard. We go back to our data table and form a conclusion together about whether or not magnetic forces will attract objects through other objects. To conclude the lesson, we will make a toy that utilizes magnetic forces. Students are given crayons or markers to create towns with roads on their paper plates. As they are working on their roads I attach a car sticker to their paper clip. The students then play/experiment using the attractive force of a magnet to drive their cars around the town they created.

Students separate their town into four sections by drawing a road. They decorate each section of their "town" with things like their house, school, stores,, etc. or however they want using crayons and stickers. Students put a sticker of a car or draw their own car and we attach the sticker or drawing to the paper clip. Students can then use the attractive force of a magnet to drive their car all over their imaginary town. Students are given a bag to take their town, magnet stick and paperclip car home. Students are assigned homework to

teach someone in their family that magnetic force can attract objects through other objects using their models.

Proficiency:
What meeting the expectations manifests as is working groups of engaged students experimenting to find the answer to an inquiry question. I will evaluate the students based on observation of their experimental procedures. I will also listen to and note the students' observations and verbal responses as these should indicate understanding of the scientific principle. At the end of the lesson, students will be able to state that magnets can attract through water and paper. They will be able to prove this statement by using their magnet stick to move their car around the paper. Students should also be able to generate questions about other objects that magnets can attract through such as cardboard, table or desk tops, etc.

An exit slip can be used to determine whether students understand the concept and process.

Magnets on the move, exit slip
- Is the attractive force of a magnet a pushing or pulling force?
- Can a magnet attract objects through water (liquids)?
- Can a magnet attract through other objects (solids)?
- What other objects do you think magnets can attract through?

Classroom teachers can use a textbook chapter test on magnetic force. Watching a BrainPop on magnetic force can be used for review and assessment.

Feedback

Teachers As Learners:
My colleagues thought that the lesson was very interactive and engaging. There is so much interactivity and opportunity for extension. They had questions about wrapping up the lesson and whether the product would go home or not.

Elements of Pretty Good Practice:
This lesson is derived from the Chicago Academic Standards for Science as well as NGSS standards

Assessing prior knowledge occurs before the lab activity. The inquiry method is used. Students discuss the question and make an individual hypothesis before the lab activity begins. We tally all responses and convert tally marks to numbers to include a mathematics element.

Students use this recorded data later in the lesson to confirm or refute their hypothesis when forming a conclusion. The lesson is active. Students use their imagination and artistic interpretations to design their own towns on the paper plate.

Modifications and Adaptations

- Differentiation Measures
- The exact procedure can be modeled for students needing more help or for students needing more challenge they can experiment to determine the best procedure.
- This lesson can be adapted for second grade by changing the mediums which the magnetic force would work through. Students could generate a list of items that they would like to test the concept of the whether or not a magnetic force would work through such as aluminum foil, wood, the table, the human body.
- The drawing itself was an extension of the activity. Maybe changing the volume of the glass, creating a data table tallying total responses, changing the density of the liquid such as attracting through syrup rather than water. Maybe put two or three plates together to change the thickness of the cardboard that the magnetic force would need to work through. Maybe assigning another activity that shows what objects are magnetic.

Questions Arisen

- My colleagues wondered how to wrap up the lesson quickly and efficiently with a reinforcement of the core idea.

Peer Feedback

- My colleagues wondered how I would wrap this up in the end. They wondered if the students take home their product or not. They wondered how kids will retain this information beyond the art culminating activity. I wonder how this information will be assessed beyond the product itself. As stated above, students take home their products to teach their family members. My colleagues thought a discussion at the end to tie it up and drive home the conclusion to the inquiry question would be helpful.

Related Resources/Ideas

If applicable: Magnetic Math -

Mostly Magnets Lab The free sample(s) below contains the table of contents, and a free activity from this book. Note: All files are pdf documents requiring Adobe Reader.

Magnetic Field Viewer (Set of 5)

Cow Magnet

Chapter 12

Kevin Cram: Classification of Matter

Kevin Cram has taught Chemistry in CPS for six years. He earned a B.A. in Chemistry from Michigan State University, a M.S. in Chemistry from Purdue University and a M.A in Teaching from Dominican University through the Chicago Teaching Fellows alternative certification program. During the 2010-2011 school year Cram was awarded a grant supported by CPS and Apple® for a classroom set of iPads. In 2012 Cram collaborated with several CPS educators to plan and develop the inaugural CPS iPad Academy professional development conference. Cram was apart of the 2012-2013 cohort of Teach Plus teaching policy fellows from Chicago focusing on teacher evaluation and professional development. Beginning the spring semester of 2013, Cram has been a DePaul faculty member in the Department of STEM Studies teaching STEM 420 - Chemistry for Teachers.

Classification of Matter

Grade Level: 8th-12th grade
Content Area Topic: Chemistry
Content Area Standard(s):
Disciplinary Core Idea
- PS1.A - Substances are made from different types of atoms, which combine with one another in various ways. Atoms form molecules that range in size from two to thousands of atoms. (MS-PS1-1)

Science and Engineering Practice
- Develop a model to predict and/or describe phenomena (MS-PS1-1), (MS-PS1-4)
- Develop a model to describe unobservable mechanisms (MS-PS1-5)

Learning Objective(s):
- Students will be able to....
- Analyze models and correctly apply the terms atom, molecule and particle to models
- Synthesize a model of a pure substance or mixture containing atoms, molecules or particles

Suggested Time Allotment: 1 class period; 45 min

Prior Lessons:
- Students should be familiar with why we use visual models for non-visual objects in chemistry
- Students should be familiar with the vocabulary of states of matter (solid, liquid, gas)
- Students should be familiar with modeling states of matter (particle views)
- Homework the night before create a "before and after" T-chart and in the "before" column define the terms atom, molecule and particle in your own words.

Subsequent Lesson:
- Students will use atom, molecule and particle vocabulary to interpret common mixtures and pure substances (i.e. Coffee, Salt Water, Pizza, Cookies)
- Students will differentiate Pure Substances into categories of Elements and Compounds
- Students will differentiate Mixtures into categories of Heterogeneous and Homogeneous

Materials & Resources Needed:

- "Classification of Matter" POGIL Model 1 worksheet - http://www.beavercreek.k12.oh.us/cms/lib5/OH01000456/Centricity/Domain/211/Classification%20of%20matter%20pogil.pdf (This link contains the entire "Classification of Matter POGIL" worksheet with answer key. I will only use Model 1 (pg. 1) in this lesson
- Kool-Aid Modeling PDF ----- https://drive.google.com/?tab=mo&authuser=0#my-drive
- Example Student "Before and After" notes - https://docs.google.com/file/d/0B_fWtw_iYNfJZnE1Y1Y0WkN0Vm8/edit
- Computer and projector (optional document camera)
- White board/poster paper

Lesson Activities & Sequence:

- "Chem Catalyst" - Display "Kool-Aid Modeling" PDF and ask students "What do you know about this matter?" Make sure to to probe students into what goes into Kool-Aid (Water, Sugar, Kool-Aid Powder). This is a whole class discussion; teacher notes student ideas on white board/poster paper) (3 min)
- Prompt students to take out their "before" definition homework and check for completion. *Have students that did not complete HW make a "before" and "after" chart in their notes. Ask students to define the terms atom, molecule and particle in your own words. For students that need support provide the blank note taking template (2 min)
- Group students in pairs and pass out Model 1 to pairs of students. Have student choose roles of "discussion speaker", "model annotator" (2 min)
- Introduce POGIL Model 1 and have student read "Why?" prompt. (1 min)
- In students pairs, ask students to analyze the model and come up with a definition for the word "atom" and write it in the "after" column of their notes (3-5 min)
- Whole class discussion on student definitions of the word "atom" (2 min)
- Repeat steps 5 & 6 with the terms molecule and particle (6-10 min)
- Display the definition of Pure Substance and Mixture (Kool-Aid Modeling PDF) and prompt students to add vocab to notes. (2 min)
- Prompt students to identify the Pure Substances in Model 1 and discuss as whole class (2 min)
- Prompt students to identify the Mixtures in Model 1 and discuss as whole class (2 min)
- Exit Slip: Show the Kool-Aid image again and ask students to create a model similar to the models in Model 1 and label whether

Kool-Aid is a mixture or a pure substance. Prompt students to use discussion from "Chem Catalyst" to guide their modeling (10 - 15 min)
- If time permits, share student models using document camera and discuss as a class or begin a concept map of vocabulary words

Assessment:
- From the exit slip, the teacher will be able to evaluate the student's ability to create a model and correctly apply the term "pure substance" or "mixture" to their model.
- Proficient Models: Display 3 types of particles (water, sugar and kool-aid powder) and correctly labels Kool-Aid as a Mixture
- Developing Models: Display at least 2 types of particles (water, sugar and kool-aid powder) and/or correctly labels Kool-Aid as a Mixture
- Unsatisfactory Models: Does not clearly display different types of particles and labels Kool-Aid as a Pure Substance

Feedback

Teachers As Learners:
The group of learners appreciated the pace of this lesson. Students were allowed to write down and share their initial ideas about the vocabulary words atom, molecule and particle with their neighbor. They appreciated addressing a single vocabulary word at a time when evaluating the nine model's. Finally they reflected on how their initial ideas about the vocabulary words may have changed after completing the modeling lesson and also expanded their understanding of these words to the vocabulary words of pure substance and mixture.

Elements of Pretty Good Practice:
The lesson incorporates whole class and small group collaboration. The teacher becomes a facilitator that allows students to share their initial conceptions and work together to modify or confirm those initial conceptions using the POGIL model. For more on POGIL pedagogy visit - https://pogil.org/

Modifications and Adaptations
- Differentiate groups of students into heterogeneous groups by academic ability
- Have larger groups (4 students) with more defined roles (i.e. Speaker, Annotator, Timer, Summarizer)

Questions Arisen
- How can students use technology to annotate and share explanations of the models in the POGIL?

- How can students use technology to generate their Kool-Aid model exit slip and share with exit slip with the teacher and/or class?

Peer Feedback
Number the 9 models (i.e. #1, #2) with marker before copying to help students talk about which box they are working on

Related Resources/Ideas
- https://pogil.org/

Chapter 13

Leslie Armstrong: Air up there, parachute challenge

I am currently a STEM specialist at Laura S. Ward STEM Elementary School located in Chicago, IL. Educating students at Laura S. Ward has been my passion for over 18 years. As a STEM specialist, my professional duties include assisting with the implementation of the STEM framework into the curricular backbone of the school. This work in progress has been realized by developing a school-wide team of teachers, providing professional development for parents and teachers, developing partnerships with universities and businesses, and creating opportunities for external STEM experiences for students and parents. During these formative years I have transformed from a novice educator to a teacher leader. Envisioning a new platform for the improvement of educating children, parents and teachers has awakened my inner being of becoming an educational activist. Our success in the future depends on the valued work we do now.

Air Up There, Parachute Challenge

Grade Level: Grades 3-5
Content Area Topic: Science

- *Unit Design:* This unit, from which this lesson is derived, is designed to introduce students to the composition of matter and its phases. Students will also learn that the behavior of matter effects other material objects. Students will study and model prototypes of apparatus that utilize air for motion This unit can be adjusted to meet the needs of students in Pre-K -5. The duration of the implementation of this unit is 2-5 days per phase.

Content Area Standard(s):

- 3-5-ETS1-2. Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.
- 3-5-ETS1-1. Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.
- 3-5-ETS1-3. Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.

Learning Objective(s):

- Students will be able to demonstrate their understanding of air resistance by designing a prototype of a parachute
- Students will gather and analyze data using precision tools
- Connect content of lesson to a literary concept

Suggested Time Allotment: 60minutes

Sequence in Learning:
Preceding Lesson and activities: Backwards movement from matter to the atom: Design challenge modeling 2 and 3 dimensional representations of molecular movements

Post Lessons Sequencing: The lessons that follow the parachute challenge are focused on the principle of designing and testing models of apparatus that utilize air for motion. The designs are based on available materials and range of student abilities

Design challenges

- Design a functional prototype of a hovercraft
- Design a balloon car that can travel the furthest distance
- Comparing densities of matter with the force of air
- Design an airbag that reduces the amount of passenger recoil

Materials & Resources Needed:

- Class Set (Approximately 20-36 Students); 1 box of facial tissue ; 100 colored adhesive dots; 1 large box of jumbo paper clips (100 ct. box); 36 feet of white string; 18 school scissors; 36 sheets of tissue paper; 36 feet of yarn; 50 paper lunch bags; 36 science journals ; 18 small reels of masking tape
- Materials Per Pair: 2 facial tissues; 2 paper clips; 4 colored adhesive dots; 2 feet of string; 2 feet of yarn 1 sheet of tissue paper; 1 paper bag 1 reel of masking; 2 science journals
- Air up there docs and powerpoint available online

Lesson Activities & Sequence

Prior to the execution of this lesson, students have been engaged in lessons and activities that focused on the makeup of matter and modeling the components of matter. Teachers should also have grouped students into academic ,heterogeneous, cooperative groups of quads. (See Air Up There "Parachute Challenge " Slide 15).

The teacher should also introduce or reintroduce symbolic language of lessons guide. (See Air Up There "Parachute Challenge " Slide 4) The purpose of utilizing these symbols is to provide visual cues and references for diverse learners. (5 minutes for symbol decoding)

Engagement 10 mins. The lesson opened with the teacher showing an image of a parachute to survey students' ability to identify this object and to spark interest. (See Air Up There "Parachute Challenge " Slide 5) The next stage of engagement involves the completion of a KWN chart. (See Air Up There "Parachute Challenge Slide 6) The purpose of this activity is to infuse cooperative thinking, discussion and writing within the lesson framework. The K column of the chart allows the teacher to gather data about students' background knowledge. The W column provides the opportunity for students to make independent determinations of what their needs are to further their understanding about this subject. The N column empowers to complete a brief educational plan of action to further their learning.

Engagement II 5 mins: The second phase of the engagement process involves a cross curricular connection to character analysis. Students are asked to worked cooperatively to identify traits that they consider an individual has in order to sky dive.

A classroom debriefing followed this activity. The debriefing will occur in an open forum; where students share responses as the teacher posts responses digitally or traditionally. As a real world connection, the teacher will correlate this activity to showing students a video about a president who skydives for his birthday. (See Media Resource Section)

Explain 10 mins.: In this process the learner will begin by making a hypothesis about how a parachute operates and make connections to the goal of engineering; to make human lives better. Students will participate in a cooperative think, discuss & write format to complete this task. The think, discuss & write process provides a format for students to safely exchange ideas verbally and in written form. Students will view a video that provides an explanation of how parachutes operate. (See media resource)

Media sources provide an additional level of support for visual learners and our diverse student population. The teacher will pause to clarify content through discussion and questioning. At the conclusion of the video, students will confirm whether their hypothesis has been confirmed or disproved.

Explore 15 mins: In this phase of the lesson, students will work in cooperative groups to design a prototype of a parachute that has the most air resistance. The teacher will use a detailed flow chart to introduce, purpose, process and criteria. Students will then be directed to explore materials and discuss materials selections collaboratively. Before students begin assembling their parachutes they must complete a sketch. Students will be given 15 minutes to create parachutes and input data into their charts. At the conclusions of this phase, student pairs will compare the performances of their parachutes to determine which prototype has the most air resistance.

Trial	Time Seconds of Drop From 3 Meters
1	
2	
.	
.	
8	

Reflection 10mins: A key portion of the inquiry process is the practice of reflection for next direction. In this process, students reflect on key questions:

- What materials did you use to construct your parachute?
- Explain how the selection of the materials effected the operation of your parachute.
- What steps would you take to improve your model?
- Provide one example of how this lesson can be improved?

Students must initially begin completing this reflective organizer independently and begin collaborative conversations and scribing

after 5 minutes. To insure that students from the diverse populations are successful at completing this portion, the format can be adjusted to interview, scribe.

Extension 5mins: At the conclusion of the lesson students will be instructed to revisit the W and N columns of graphic organizers to and identify one idea that they would like to explore further They will present new findings in a creative and exciting way. Examples: compose a rap or a song, create a video, interview a primary or secondary source, use mixed media. The teacher will present rubric and timetable at the next class session

Proficiency: (Complete Next Class Session): In order to provide a standard of continued growth in student achievement and teaching pedagogy, a rubric provides a lens of structured tasks that supports the growth and reflective process. The evaluative criteria have a direct connection to the standards and objectives that were embedded in this lesson. The teacher should meet with each pair of students to review their performance and should be combined with the student commentary in their reflective journals.

Advanced 4	Proficient 3	Emerging2	Beginning 1
Appropriate materials were selected, an ample attempt was made to transform materials into a prototype that led to effective operation	Appropriate materials were selected, a moderate attempt was made to transform materials into a prototype that led to moderate operation	Inappropriate materials were selected, an moderate attempt was made to transform materials into a prototype that led to ineffective operation	Inappropriate materials were selected, a minimal attempt was made to transform materials into a prototype that led to ineffective operation
Journal entry contained a detailed sketch, evidence of modifications and several data entries	Journal entry contained a detailed sketch, evidence of some modifications and 4 data entries	Journal entry contained a moderate sketch, evidence of some modifications and 3 data entries	Journal entry contained a minimal sketch, minimal evidence of modifications and at least 2data entries

Feedback

Elements of Pretty Good Practice:

- Appealed to diverse learners: Kinesthetic, visual, interpersonal
- Transitions were flawless
- Visuals: Organized ppt
- Visuals and auditory cues
- Unit is scaffolded nicely

- Activate prior knowledge through graphic organizer
- Evidence of thorough planning
- Inquiry based
- Integrated writing speaking standards

Modifications and Adaptations
- Vocabulary-Concept maps (air resistance and gravity)
- Pictorial representations of instructions
- Graphing the time for each drop (Math Connection)
- Link layers of the atmosphere to this lesson
- Integrate literacy such as "Humpty Dumpty"

After reflecting on the lesson, I would recommend that I should have included the use of technological devices such as ipads to aid students in capturing their responses to questions and providing a resource to review processes.

Questions Arisen
- How can additional sources of technology be utilized to enhance the lesson?
- How can the other content areas be integrated into this lesson?

Chapter 14

Mahesh Alur, PhD: Balancing Chemical Reactions – Guided Inquiry

I have been a teacher for 10 years. I taught for two years (2004-2006) at Hirsch Metro High School on Chicago's south side, for five years (2006-2011) at Lake View High School on Chicago's north side, and for one year (2011-2012) at Charles A. Tindley Accelerated School in Indianapolis. Currently, I am about to begin my third year (2012-present) at Amundsen High School in Chicago's Bowmanville neighborhood. Go Vikings!

Previously, I studied Molecular and Cancer Biology at Northwestern University where I received my PhD. Previously, I attended the University of California, Davis where I received a BS in Biochemistry. I currently live in Chicago's Edgewater neighborhood with my wife, son, and two cats. In my copious amount of free time (ha!), I like to spend time with my family, watch TV, read, and think about running.

Balancing Chemical Reactions – Guided Inquiry

Grade Level: Applicable to middle school and above
Content Area Topic: Chemistry
Content Area Standard(s):

- MS-PS1-5: Develop and use a model to describe how the total number of atoms does not change in a chemical reaction and thus mass is conserved.

Learning Objective(s): Students will be able to balance chemical reactions.

*Suggested Time Allotment:*15-45 minutes

Sequence in Learning:

- Students will have just completed an inquiry activity about how to prove the law of conservation and they have watched my instructional video on YouTube (link below) about balancing chemical reactions on the previous night. Students will rewatch the video after this activity to solidify their knowledge.
- On subsequent days, students should be practicing balancing through worksheets. This knowledge will be used to calculate stoichiometric values in chemical reactions.

Materials & Resources Needed:

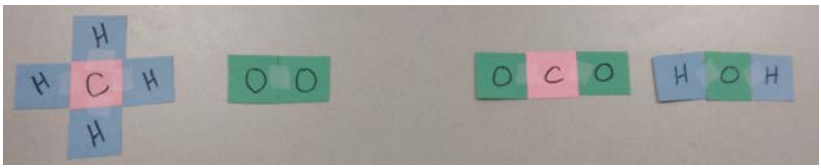
- 3 colored pieces of paper per group/scissors/tape/markers.
- My YouTube video (many others are also available):

Lesson Activities & Sequence:
Students are sitting in academically heterogeneous groups or in homogeneous groups with occasional help from students who acquire the information more quickly. With heterogeneous grouping, higher achieving students can assist students who are struggling with the material. In this scenario, these higher achieving students' knowledge becomes questioned and/or solidified. The author employs a flipped classroom strategy, so homogeneous groups can be supported by the teacher and by other students who have already completed balancing.

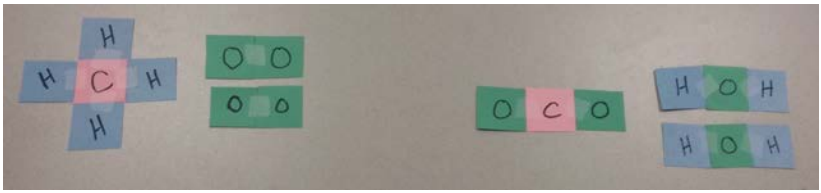
I use POGIL methodology (http://www.pogil.org). Use groups of 4-5 students. Each student has a particular role that they conduct faithfully towards successful completion of the assignment. Please consult the above website for more information.

One group of materials is given per group so that they can cooperatively manipulate and share knowledge. Correct orientation of the atoms in a molecule is not required.

The setup of the problem on the handout:



The answer:



Different methods to balance equations are given verbally by the teacher (doing it visually, polyatomic groupings, using a table, checking after complete, odds vs evens, etc.) during practice. In addition, the YouTube video provides some of these strategies.

Proficiency:
By the end of the period, all students should have a general idea of how to balance chemical reactions. I check work by seeing how each student progresses through practice questions on the handout. I provide feedback and assistance where necessary. Proficiency on balancing cannot be demonstrated until more practice questions are attempted. More practice, for homework or in class the next day, will have to be used to solidify this skill. Individual completion of assignments ultimately indicates to the teacher if mastery knowledge is being reached. Ultimately, I provide a 5 balancing questions on a quiz along with a short answer question to assess student mastery.

Feedback

Teachers As Learners:
Color-coded manipulatives were useful. It was an advantage that students could write on them. The student roles were very descriptive and helpful. Student worksheet were clear and helped guide the activity and allowed students to work independently (to explore and make mistakes). The teacher acted as facilitator.

Elements of Pretty Good Practice:
Teacher acted as a facilitator. He gave materials and clear instructions and stepped back. The use of colorful manipulatives allowed students

to create models of the balancing reaction. The teacher provided appropriate positive reinforcement based on observed student behavior. He ensured that all students were participating by tryinh to pull in students into the conversation equitably. He also ensured that students were carrying out their roles faithfully.

Modifications and Adaptations:
Extra sets of manipulatives could be provided. The author has used bead models in which he assembled each reactant and product in a plastic sealed bag in which each molecule had to be identified prior to balancing. The author has found that this lead to a "quick win" for students who might find balancing chemical reactions challenging.

Questions Arisen
Can students have more access to the manipulatives individually?
What's the best way to group students?

Related Resources/Ideas
- You tube videos on my youtube channel
- Balancing Chemical Reactions – POGIL 2 (Handout)

Chapter 15

Manuel Acevedo: Math with Skittles

As a technology teacher/coordinator, and former math teacher and coach, I value the time I spend with students, parents, and with teachers in their classrooms. I am passionate about providing a creative and active learning school environment that promotes the importance of a STEM education in everyone's lives. I support teaching and learning that involves collaborating, planning and discussing best practices. This focal point has helped me create a school environment where every student can learn and enjoy STEM subjects.

Math with Skittles

Grade Level: 6th
Content Area Topic: Mathematics: estimating, sorting, classifying, number relationships, computation, fractions, decimals, percents, angles, probability, interpreting graphs

Content Area Standard(s):
- CC.7.SP.5 Investigate chance processes and develop, use, and evaluate probability models. Understand that the probability of a chance event is a number between 0 and 1 that expresses the likelihood of the event occurring. Larger numbers indicate greater likelihood.
- CC.7.SP.6 Investigate chance processes and develop, use, and evaluate probability models. Approximate the probability of a chance event by collecting data on the chance process that produces it and observing its long-run relative frequency, and predict the approximate relative frequency given the probability.
- CC.7.SP.8b Represent sample spaces for compound events using methods such as organized lists, tables and tree diagrams.
- CC.6.SP.5 Summarize and describe distributions. Summarize numerical data sets in relation to their context, such as by: Reporting the number of observations; Describing the nature of the attribute under investigation, including how it was measured and its units of measurement; Giving quantitative measures of center (median and/or mean) and variability (interquartile range and/or mean absolute deviation), as well as describing any overall pattern and any striking deviations from the overall pattern with reference to the context in which the data was gathered.

Learning Objective(s):
- Students working with Skittles as manipulatives will review and reinforce their math knowledge of angles, geometric shape, classifying and determining the probability color from a package of Skittles.
- They will analyze color data and calculate its probability as a fraction, decimal and percent.
- Students will calculate the mode, mean, median, and the range of the Skittles data and record and interpret their data on student created tables and graphs.
- Overall, students will experience hands-on learning with collecting, analyzing and interpreting data while creating tables and graphs.

Suggested Time Allotment: 1hour

Sequence in Learning:
Prior to the lesson students would have studied or reviewed angles, geometry, probability, fractions, decimals, and percents.

Materials & Resources Needed:
4 large 14 ounce Skittles bag, 30 Dixie cups, 30 Construction papers, 30 brown paper bags, Computer

Lesson Activities & Sequence:
Show the following two Skittles video as an introduction for creating with Skittles.

- http://www.youtube.com/watch?v=yZvGBc6TxIc
- http://www.youtube.com/watch?v=aHNxfhV5Qao

Explain to your students that they will be working with Skittles to create and review math symbols and concepts.

- Let students understand they will be allowed to eat the Skittles after they collect their data.
- Have students create a 6X2 table using Microsoft Word to record their Skittles data. Display your table on the projection screen and circulate and assist any students who need help.

Green	Orange	Purple	Red	Yellow	Total

- Give each student a Dixie cup full of Skittles and inform them to resist not to eating any Skittles until you give them permission.
- Have students estimate how many Skittles are in their Dixie Cup and to record their estimate on their construction paper. Review what it means to estimate.
- Write 90 degrees and 180 degrees on the white board.
- Ask students to use their Skittles to create a model of these angles on their construction paper.
- Circulate and check for understanding and provide feedback to students. Afterwards, look for students to demonstrate their models to the class using a document camera.
- After a couple of student examples, write the words Acute and Obtuse on the white board and have students create a model of these angles.
- Circulate and check for understanding and provide feedback to students. Afterwards look for students to volunteer their models to the class using a document camera.
- Model and complete your 6X2 table for your students.
- Have students sort, count and record their different colors Skittles data on their data tables and have them discuss and compare their

data with their elbow partner.

- Ask how did their data compared to their partner?
- Ask were they the same or different? Why or Why not?
- Have students add the different colors count and come up with a total number of Skittles to record in their table.
- Have students compare their actual total to their estimate and have a couple of students share their estimations.
- Project your 4X6 table and have students reproduce your table in their open document

Color	Fraction	Decimal	Percentage
Green			
Orange			
Purple			
Red			
Yellow			

- After student a have completed their new table, review with students the definition of probability and demonstrate how to find the probability with your Skittle data.
- Pour your Skittles into a small paper bag and ask your students which color do you have the highest probability of pulling out without looking and which color would you have the lowest probability of being selected.
- Pull out a Skittle and review your result. If it is the color with the highest probability or not, or the lowest probability or not explain to your student that probability is a measure of how likely an event occurs not THAT THE EVENT IS CERTAIN. Review the importance of math vocabulary.
- Have students pour their Skittles in their paper bag and without looking pull out and test their probabilities. Explain to students to think about their results eat the Skittles and start again. Explain they can start eating their Skittles.
- Circulate and discuss their results.
- After a couple of minutes, model calculating probability as a fraction, decimal and percentage. Review how to convert from fraction to decimal and to percentages with your data using your table.
- Have students complete their calculations and record them in their table. Circulate and check for understanding.
- Have a couple students share their calculations.
- Project a 2X4 table with range, mean, mode and median displayed.
- Review with students the definitions and how to record the mode, median, mean and range with your data.
- Have students create their final table to record their mode, median, mean and range data.

Range	
Mean	
Mode	
Median	

- Have students calculate and record their range, mean, mode, and median.
- Circulate and check for understanding and provide feedback to students. Afterwards look for students to volunteer their data.
- Have students use their data to create a bar graph using http://nces.ed.gov/nceskids/createagraph/default.aspx or for more advance students use Microsoft Excel.
- Have student email their documents for assessment.

Proficiency:
- Students' models will demonstrate their content knowledge regarding angles.
- Students' tables will demonstrate their ability to calculate the probability and statistics of each color of Skittles.
- Students work will be check for understanding by correct calculations based on their data and graphing results.

Feedback

Teachers As Learners:
- Hooked students with Skittles
- Video Clip sparked creativity
- Hands on engaging activity
- Reviewed concepts studied previously

Elements of Pretty Good Practice:
- Integrated multiple math domains: geometry, probability and statistics
- Used manipulatives for student learning
- Appeals to diverse learning styles: kinesthetic, interpersonal, visual
- Parameters were clearly given before the activity

Modifications and Adaptations
- Refer to anchor charts during instruction
- Provide students with IEPs and ELLs with "thinking partners"
- Create Frayer Models- Meaning, Example, Non-Example, Characteristics
- Jigsaw presentations to groups

Peer Feedback

- Add Skittles to a container to calculate volume
- Use larger bags of Skittles to do data analysis with upper grades
- Additional math concepts such as array, area, perimeter, lines

Bibliography: Internet Resources

- www.skittles.com
- http://www.youtube.com/watch?v=yZvGBc6TxIc
- http://www.youtube.com/watch?v=aHNxfhV5Qao
- http://www.theteacherscorner.net/collaboration-projects/skittle-rainbow/skittles-activity.php
- http://lessonplanspage.com/cimathwhatcolorskittles-spreadsheetgraph56-htm/

Chapter 16

Anna Puleo McGowan: Cells Alive! An Exploration of Animal Cells

Teaching was my first passion as a student in Boston. Before becoming a teacher, I worked in other professions such as the music industry, social work, health care marketing and advertising. I realized that I wanted to share my love of learning with students and to contribute positively to urban public schools.. After completing the Chicago Teaching Fellows Program, I have worked as a Middle Grades science teacher for the past 5 years, most recently at Sauganash Elementary School. Next, year, I will be teaching STEM for students in grades K-8. I have a Bachelor of Arts degree in Biological Anthropology from Harvard College, a Master of Health Services Administration from the University of Michigan (Go Blue!) and a Master of Arts in Teaching from Dominican University. When I am not teaching, I enjoy spending time with my three children, cooking Italian food, reading and listening to music.

Cells Alive! An Exploration of Animal Cells

Grade Level: 7
Content Area Topic: Life Science - Cell Structure and Function
Content Area Standard(s):

- MS-LS1-2. Develop and use a model to describe the function of a cell as a whole and ways parts of cells contribute to the function.

Learning Objective(s):
The purpose of this activity is to explore the structure and function of animal and plant cells. The students will then be able to construct a model of an animal cell using household items and will be able to explain their choices for selecting the items in order to represent the parts of the cell.

Suggested Time Allotment: 60 minutes

Sequence in Learning:
We just finished a unit on human body systems, where we learned that each body system has a collection of organs and tissues that perform very unique functions or jobs in the body. Now we are going to explore the next level in your body - the cellular level. The lesson will prepare students to dive deeper in the individual parts of the cell so that they have some contextual knowledge. The next lessons will involve exploration of cells on microscopes, and creating a cell model of plant cells.

Materials & Resources Needed:
Ziploc bags (2 per student pair); A variety of materials to represent cell parts, such as buttons, pasta, pipe cleaners, and beads; 1 cup of Karo syrup for each student pair; Inside a Cell worksheet; Cells Alive interactive website (www.cellsalive.com); Access to computer or tablet;

Activity is based on the lesson below:
http://sciencenetlinks.com/lessons/cells-1-make-a-model-cell/

Lesson Activities & Sequence:
Teacher began by connecting the lesson to the previous unit on human body systems and explained that the next unit would explore the structure and function of cells. Teacher then directed the students to log into the Cells Alive website (www.cellsalive.com) and explore the simulation that shows the parts of the animal cell. Students were then given an Inside the Cell worksheet and were then directed to work in elbow pairs to complete the worksheet using the simulation as a guide. The goal of the exercise was to expose students to the

structure and function of animal cells using technology. Students were given fairly dense definitions of the cells, and they were directed to simplify the definitions and paraphrase them in their own words. After ten minutes of this activity, the teacher explained that the next section of the activity would allow them to "build" a cell model using various items (i.e., skittles, pasta, beads, etc). Students were given the remaining 20 minutes to put their cell models together, and also complete the worksheet.

Proficiency:
Students will have completed the "Inside the Cell" Worksheet that has the descriptions of the organelles and their functions paraphrased in their own words. Students will also have completed a model of an animal cell using the materials that were provided in class. Students will also have a baseline understanding that the cell is similar to a human body system in that it too has parts that perform specific functions. I will evaluate the assignment based on the degree of completeness of the worksheet and the verbal explanations that students gave about their cell model. The lesson is designed to be assessed formatively. Teachers should grade the worksheet based on the level of effort completed and the cell model should have a minimum of ten objects within the "cell membrane."

Feedback

Teachers As Learners:
Students enjoyed the interactive nature of the cells alive website in exploring the defining the parts of the cell. They also enjoyed creating unique cell models using a variety of interesting items. Some students preferred to play around on the simulation and complete the worksheet while the others took more delight in the selection and justification of the items used to represent the parts of the cell. Students felt the manipulatives helped convey the meaning of the parts of the cell.

Initially students had trouble finding the website and the correct link that they needed to find, so possibly the directions were not as clear as they should have been. The sixty minute session was condensed into 30 minutes for demonstration purposes, so a few students did not have an opportunity to finish the worksheet.

Students could have been prompted more frequently to explain why they were choosing the specific objects they did to represent the parts of the animal cell. Students were asked to move on prematurely from the worksheet phases so they could experience putting together the cell model, and students in a real classroom setting would have been given

more time to complete those sections.

Teacher was very warm and approachable. Teacher also encouraged people to work through the difficult words in the simulation and focused on understanding the big picture in addition to the specific parts. Students liked the exploratory and interactive nature of the lab, and appreciated that the teacher did not model a sample "cell model." The goal was to get an introduction to the cell structures and functions, and it was OK to work through the difficult parts of the simulation. Teacher was very flexible when issues arose with the technology and facilitated students quite successfully.

Elements of Pretty Good Practice:
Teacher connected the prior unit on human body systems to the lesson, which was the beginning of the cell unit and explained the parallels between a system and a cell. Teacher also activated prior knowledge and asked students what cell structures and functions that they already know. Teacher used an interactive website (www.cellsalive.com) to allow students to explore the names and jobs that the organelles have in an animal cell. Teacher also provided a kinesthetic exercise that allowed student pairs to create an unique cell model, all the while asking them to complete a worksheet which asked them to paraphrase and synthesize the complex text in the cells alive simulation. Students worked cooperatively in pairs, and teacher acted as a facilitator for the majority of the teaching demonstration. The lesson was great for differentiation - the number of cell parts could have been shortened for the first lesson.

Modifications and Adaptations
In other classroom settings, students could have been asked to bring materials from home to increase their engagement in the cell model building. Also, can extend the activity to a plant cell.

Questions Arisen
My colleagues wondered if students should have been asked to formally explain why they chose the items that they did in their model. They also wondered whether students would have access to technology to complete the assignment. They also wondered whether it was a one-day or a two-day lesson.

Peer Feedback
Overall, my colleagues enjoyed the lesson and thought it was a good mix of technology, language arts, and hands-on learning. They appreciated that I did not model how to build the cell model, because they felt that would bias a learner to make the same creative choices.

Chapter 17

Rolando Argumedo, Jr.: Solar Power Investigation

Rolando Argumedo, Jr., or RJ has been an educator for 12 years with the Chicago Public Schools. He has taught Literacy and Science in grades 5-8. RJ is a HUGE baseball fan, as he roots for the Cubs and the Yankees. He is also an advent theatergoer and a wannabe New Yorker. You can find him on Twitter @BWAYCHI.

Solar Power Investigation

Grade Level: 6th
Content Area Topic: Energy
Content Area Standard(s):
- MS-PS3-2: Develop a model to describe that when the arrangement of objects interacting at a distance changes, different amounts of potential energy are stored in the system.
- Science & Engineering Practices: Planning and carrying out investigations; Analyzing and interpreting data

Learning Objective(s):
- I can investigate factors that affect solar panel output.
- I can analyze and interpret data to determine the most effective solar panel orientation [or position(s)].

Suggested Time Allotment: 60 minutes

Sequence in Learning:
Prior to the solar polar investigation, students completed an investigation on wheel alignment, aerodynamic drag, and front-wheel and rear-wheel drive. After this investigation, students began to sketch their solar power cars along with developing a material list. Finally, students build, tested, and raced their cars.

Materials & Resources Needed:
Solar Panels, Voltmeters, File Folders, Transparencies, Protractors, Student Sheets, Chart Paper

Lesson Activities & Sequence:
- The teacher will show students a solar panel. Note: This is the same panel students will use later in the activity.
- Students will share out where they have seen solar panels around them.
- The teacher will show students three real world examples where solar panels were used to generate energy.
- The teacher will explain the investigation to students. Teachers will explain what a voltmeter is (an tool for measuring electric potential in volts). Students will use a voltmeter to measure the energy output of the solar panel, which will be orientated in several different positions (e.g. parallel to the ground; angling towards the sun; 2/3 covered using the file folder; 1/3 covered using the file folder; and covered with the transparency). Students will document their data using a Student Sheet. Important Note: Inform students to set the voltmeter to the DCV 20 setting.

- Before testing the solar panels have students make a prediction on which solar panel orientation will have the greatest energy output and the least energy output.
- Grouping: Students will work in groups of two; however, they select a new partner for this investigation. Note: For every new investigation, students must select a new partner. Thus, if two students worked together during the wheel alignment investigation, then they cannot work with each other again.
- Take students outside to test their solar panels.
- Once back in the classroom, students will answer the two analysis questions on their student sheets.
- As students are completing these questions, call each group up to write their results for the solar panel orientation that produced the greatest and least output on the "Class Results" anchor chart.
- Next, discuss the results with the students. What did they notice? Which orientation produced the greatest output and why? The least and why? Were your predictions correct? How can we use this data going forward? How will this investigation influence your design?

Proficiency:
Students will be assessed through collaborative conversations. Students will be engaged in peer-to-peer and classroom discourse centered on factors that affected the energy output along with analyzing and interpreting their data. The next activity, sketching their solar powered cars, will reinforce these learning targets, as the teacher will view how students orientated their solar panels on their sketches.

Feedback

Teachers As Learners:
- The lesson had a preview, which showed how it fit into the larger context of the unit
- The preview included visuals (e.g. a real solar panel and how solar panels have been used in real life)
- The lesson was engaging since it was hands-on and collaborative

Elements of Pretty Good Practice:
- The lesson connected to an authentic application (designing a solar powered car)
- The teacher gave students time to ask questions and allowed other students to answer the question or figure out the answer themselves

Modifications and Adaptations
- Connect to an energy unit and different renewable and non-renewable sources

- Learn about history of solar power development
- Scavenger hunt of different uses of solar power in the community

Questions Arisen
- How does the solar panel work?
- What's the faulty logic in powering a solar panel with a non-renewable source?
- How to design a controlled experiment using solar panels?

Bibliography:

- 2014. Solar power-up: Solar panel investigation. Peggy Notebaert Nature Museum. Modified by Rolando Argumedo, Jr.

Appendix A: Student Sheet

Appendix A: Student Sheet

Name:_____ Date:_____

Solar Power-Up Lab: Solar Panel Investigation Student Sheet*

Learning Targets
I can investigate factors that affect solar panel output.
I can analyze and interpret data to determine the most effective solar panel orientation [or position(s)].

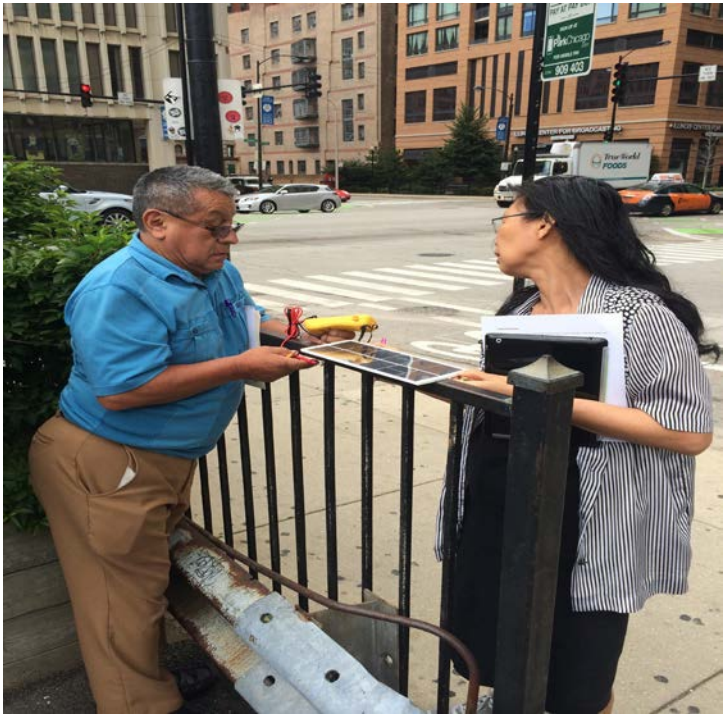
Materials
Solar Panel Voltmeter File Folder
Transparency Protractor Student Sheet

Time of Day:_____ (AM or PM)
Location:_____

Data Table

Solar Panel Orientation (Position)	Volts	Notes
Parallel with the ground		
Angling towards sun (Angle Measure: _____)		
2/3 covered with file folder		
1/3 covered with file folder		
Covered with clear plastic		

Analysis Questions
1. Which orientation (position) of the panel had the greatest output and why? The least output and why?
2. How will the data obtained from this investigation influence your solar power car design?
*Source: Solar Power Up, Peggy Notebaert Nature Museum, 2014, Modified



MSU-Wipro Urban STEM Fellows In Action

Chapter 18

Roberto Lituma: Create, and Animate Objects in eTOYS

I was born in Ecuador, and I came to the United States in 1982. I am married and have 5 children. At the beginning of my career I worked as a teacher in technical schools in the field of mechanics as well as working as an industrial mechanic. My specialty was welding, and machine operating. Later, I was curious to experience a new field and I moved to Silicon Valley, California to work as a testing engineer. In 1993 I came back to teaching and I have been working as an elementary teacher since then. I like to teach mathematics, and my hobby is playing soccer, which I practice with the students at the school where I am currently working.

Create, and Animate Objects in eTOYS

Grade Level: Grade 5-8
Content Area Topic: This lesson is on Computer Programming: the students will animate drawing objects with the use of scripts. The animated objects will perform well-defined actions, and apply mathematics: using Measurements, Geometry, and Algebra.
Content Area Standard(s):
COMMON CORE STANDARDS: Technology Standards

- Reading RI.5-7. Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently.
- Writing standards W. 5.7. Conduct short research projects that use several sources to build knowledge through investigation of direct aspects of a topic.
- Language L.5.6 Acquire and use accurately grade-appropriate general basic and domain-specific words and phrases, including those that signal contrast, addition, and other logical relationship.
- CCSS-Math Standards (Domain: Expressions and Equations)
- OA.2 Write simple expressions that record calculations with numbers and interpret numeral expressions without evaluating them.
- NF.5.a Interpret multiplication as scaling (resizing) Compare the size of the product to the size of one factor on the basis of the sizes of the other factor, without performing the indicated multiplication.
- EE.6 Use variable to represent numbers and write expressions when solving real-word or mathematical problems; understand that the variables can represent an unknown, or, depending on the purpose at hand, any number in a specified set.
- 6. G.4 Represent three-dimensional figures using nets made up of rectangles and triangles, and use the nets to find the surface area of these figures.

Learning Objective(s):

- Recognize scripts in a computer program.
- Solve multi-step problems based on real-life situations.
- Draw geometric shapes.
- Create algebraic expressions and apply to the motion of an object.
- Know and apply the property of integers, and generate motion.

Suggested Time Allotment: 60 min.

Sequence in Learning:

- Briefly review requisite and subsequent lesson(s)
- Discussion/Activities/Key Terms
- Planning and Preparation. - This Lesson is on Computer

Programming. The Objectives of this lesson are for students to learn the role of the computer programs in the real world, and to promote the mathematical curiosity, persistence, precision and logical thinking. The students will apply their geometric concepts of figures like circles, squares, and different lines, as well as basic concepts of algebra using variables associated with time.

Procedures.
The class will use Etoys: Which is a student friendly computer environment and object oriented prototype program. Our goal is to make a design: in this case a simple car with a few characteristics and attributes inspired in a similar project on one of the Etoys activities. The main purpose of the exercise is to develop problem-solving skills. In the course of completing the activity the students will cover a number of cross-curriculum standards including computer design, drawing, and public speaking when they present their work.

Materials & Resources Needed:
Desktop computers, Projector, Internet Connection, Elmo, Flags (3 colors), Quick Etoys guides on: navigation, paintbrushes, halos, and supplies. Rubrics.
Vocabulary: Navigator Bar, Paint tools, Halo Handles, Supplies, Object Catalog, Scrip tiles, Menus, commands, tests. This words will be used during the programming and will give directions and facilitate the accomplishment of the task. Do you have attachments with the information contained in the Etoy guides mentioned?

Lesson Activities & Sequence:
The students will be divided in groups of 3 and I considered mixing students with high and low scores, the groups can work together, or make their plans, and discuss their ideas and work individually on their own computer. Groups can present one project or each member presents their project.
We will present the task and review the steps, and program functionality (Review: Painting Tools, and Halo functions of the program with all the details.
The teacher will develop one example of a geometric figure and make it perform movements, to learn about angles, negative numbers and other characteristics that the motion of the object will present to engage the students in the task.
Then, the students and the teacher will do an activity together. Using the paintbrush will draw an object, and with the "halo commands and scripts" will do the animated simulation similar to the projected task.
The student will make a drawing of a an object (car) make the car go forward by 100 units, turn 90 degrees left, turn 90 degrees right, adjust

the variables x and y, and use the variables randomly. The teacher will assist the students or groups who have questions or problems to solve. Also, I will go around the room, to make sure the students are working with confidence and getting their goals.
To complement the activity the teacher will call some students and ask them to program to each other taken places of programmer and object. The next group will write a program to draw a geometric figure. The students, who finish the task first, will take the car to the road and drive them on the right, left, or center of their designed road. The students will share their project to their classmates, using the projector, and visiting different groups.

Adaptations and Modifications
Students with IEP's or special needs will have partners to work with, and one on one assistance for ELL. The students with IEP's will have a special guide to follow and their tasks will be accommodated. (See student's accommodations) Do you have a copy of the special guide?

ETOYS PROJECT: Please get familiar with the painting tools, halo Command, panes, tiles, actions and properties, read the information, and follow the directions: Open Etoys and click the question mark in the top left corner of the Etoys Navigator Bar to open the set of Quick Guides. Here is where you will find a range of topics of interest.

Halo Handles: The colored Icons surrounded an object allow for different manipulation and change to that object. Every object has a set of halo handles. Right click on anything to revel its icons. Each icon is supplied with balloon describing its function.

Script: Objects can be sent messages and instruction by combining titles and running them in a scriptor. Please name the scripts as soon as you create them.
Scripting: The Viewer shows categories and properties and instructions for the object represented by tiles.
Click the Yellow exclamation point to run a particular instruction.
Drag a title and drop it on the screen to form a script.
There are many categories of title, click on the category name, like basic, to open a menu of categories.

Now please assemble scrip tiles for commands such as: Forward, Turn, and complete your task. ANIMATE AN OBJECT (your choice) You may select from the supply Box.

For students who finished the first assignment.
ANIMATE AN OBJECT. (CAR)

To change the category of tiles appearing in a pane, use the pull down menu at the top of the pane.
CREATE A SCRIPT TO MAKE THE CAR MOVE FORFARD.

Proficiency:
When the students accomplished their task the entire activity will be on the computer display, and the satisfaction of their creation will be reflected with a big smile or WOW exclamation.
Finally, as an evaluation or assessment the students will write on a paper their interpretation of the script that performs the task on their object, and final projects will be presented to the entire class or shared using the Google drive. (evaluation questions and rubric is attached)Is there a rubric for this paper? What types of information do you look for students to mention in this paper to ensure they have masted the ideas presented in the assignment?

Review Questions Briefly answer the questions below.
- Can you tell in your words what a "halo" of an object is?
- How do you open a "viewer" for an object?
- Name some properties of an Object.
- How can you make an object move forward?
- How can you make an object move backwards?
- How can you make an object change the direction of the "turns"

Assessment Rubric

Category	4	3	2	1
Content	Excellent evidence of background work and critical thinking. All facts and major concepts and Ideas accurately stated.	Includes essential knowledge about the topic. Most facts and major concepts and Ideas accurately stated.	Includes essential information about the topic. Some facts and major concepts and Ideas accurately stated.	Content is minimal Few facts and major concepts and Ideas accurately stated.
Organization	Content is very well organized and logically sequenced.	Content is mostly organized and logically sequenced	Content lacks some organization and logically sequenced	No clear or logical organizational structure, just lots of facts.
Originality	Product shows a large amount of original thought. Ideas are creative and inventive.	Product shows some original thought. Work shows new ideas and insights.	Uses other people's ideas (giving them credit), but little evidence of original thinking.	Uses other people's ideas, but does not give them credit.
Requirements	All requirements are met and exceeded. All group members were participaing and contributing to the activity	All requirements are met. Most of the group members are on task and participating	One requirement was not completely met. The group members were easily distracted.	More than one requirement was not completely met.The group was off task the majority of thet ime.

The homework assignment would be to plan a challenging activity like to write scrip to drive their car (drawing- object) from a parking lot to the garage.

Feedback

Teachers As Learners:
The teacher presented the project with a physical role-play calling a volunteer to program giving and executing the commands. The teacher models the activity, pointing out that tutorials were available for any one who needed. The teacher encourages the students to try and play with the program before the activity, confidence and enthusiasm were transmitted to the class. The students had a choice of designing any object besides the car that was use in modeling activity.

Elements of Pretty Good Practice
The teacher used the student choice for designing the object. Modeling the activity. Also using the strategy I do it, we do it, you do it. And the gradually release of responsibilities, ask students to answer their own questions by throwing students questions out to the class for response, and individual check-ins during the activity.

Modifications and Adaptations
- The students can create an animation that demonstrates a content area concept.
- We recommend the students to write their own guide and challenge another student to solve the problem.

Questions Arisen
- What is the best way to accommodate learners that want/need to get started right away as well as learners that want/need the teacher to model?
- What might this activity look like with older students? younger?

Chapter 19

Rosalind Ali: Getting Ready to Ride (Data Tables and Graphs

Rosalind Ali is a middle-grades Math and Algebra teacher in the Chicago Public School system. She holds a B.S. degree in Computer Science from the University of Detroit-Mercy and an M.S. degree in Education from Indiana University-Indianapolis. Rosalind began her professional career in the IT industry. Seeking new and exciting challenges, she earned teaching credentials at the University of Illinois-Chicago and just finished her 12th year as an educator.

Getting Ready to Ride (Data Tables and Graphs)

Grade Level: 6th
Content Area Topic: Algebra
Content Area Standard(s):

- 6.RP.A – Understand ratio concepts and use ratio reasoning to solve problems (6.RP.A.3a)
- 6.NS.C Apply and extend previous understandings of numbers to the system of rational numbers (6.NS.C.8)
- 6.EE.C Represent and analyze quantitative relationships between dependent and independent variables (6.EE.C.9)

Standards for Mathematical Practices:
Practice 1: Reason abstractly and quantitatively: Students are engaged every day in solving problems and, over time, learn to persevere in solving them. To be effective, the problems embody critical concepts and skills and have the potential to engage students in making sense of mathematics. Students build understanding by reflecting, connecting, and communicating. These student-centered problem situations engage students in articulating the "knowns" in a problem situation and determining a logical solution pathway. The student-student and student-teacher dialogues help students not only to make sense of the problems, but also to persevere in finding appropriate strategies to solve them. The suggested questions in the Teacher Guides provide the metacognitive scaffolding to help students monitor and refine their problem-solving strategies.

Practice 4: Model with mathematics: Students conduct a jumping-jack experiment to simulate a bike-riding trip. They make a table and graph of their experiment and evaluate their data. Students see that the difference between two adjacent table entries, divided by 10, tells the number of jumping jacks per second. They also see on their graphs that greater rates are shown by bigger jumps upward from one data point to the next. Students identify and record their personal experiences with the Standards for Mathematical Practice during the Mathematical Reflections at the end of the Investigation.

Learning Objective(s):
Students will be able to construct a graph using a variety of technologies from a table of data that depicts change over time. Student will be able to describe the pattern of change represented in the graph.

Suggested Time Allotment: 60-90 minutes

Sequence in Learning:
The goal of this Investigation is to develop students' ability to look for quantities that change over time, especially distance and speed of moving objects, and their ability to construct and interpret data tables and coordinate graphs representing patterns in that change. This introductory lesson should be followed with lessons that provide additional problem solving opportunities for students to create data tables, coordinate graphs and written descriptions of patterns of change. Students should be able to understand the value of each type of representation and determine when to use each. In this curriculum, these mathematical goals are pursued through work on four Problems in the context of planning and pilot-testing a three-day cross-country bicycle trip from Atlantic City, NJ, to Williamsburg, VA.

We suggest that you launch this Investigation with some class discussion of the bike tour context. You can use the information provided about the RAGBRAI (Register's Annual Great Bike Race Across Iowa) or find information and video clips of other similar bike tours that occur in many other states. You can move from that general discussion to the specific challenge of Problem 1.1 by asking students to think about this question:

- How are the cyclists' speed and distance covered likely to change throughout a day?

Materials & Resources Needed:
Student Edition Problem 1.1 : vp1-1.doc (excerpt from Variables and Patterns, Connected Math); Labsheet 1.1A: Jumping Jack Fitness Test (labsheet 1-1a.doc); Labsheet 1.1B: Jumping Jack Tables and Graph (labsheet 1-1b.doc); Graph Paper; Stop watches; Launch Video (from Connected Math website); Web based graphing tool; RAGBRAI (Register's Annual Great Bike Race Across Iowa): http://ragbrai.com

Lesson Activities & Sequence:
This lesson is the third critical area of focus for 6th graders lesson in the sequence of materials they will cover in the year. Prior to this lesson students have studied ratios and proportional relationships and the number system. Students would be expected to know foundational mathematics including graphing in the first quadrant. The next lessons will allow students to have opportunities to reason about and solve one-variable equations and represent and analyze quantitative relationships between dependent and independent variables.

Do Now

- Find the length, width and area of all rectangles with a perimeter of 24 meters. (whole number lengths & widths)

- Describe the relationship between the length and areas of rectangles whose perimeter = 24 meters.

Do Now - Teacher Guide: Suggested Questions

- Describe the relationship between lengths and areas of rectangles that have fixed perimeters: As the length increases, the area increases to a maximum point, and then it decreases in the same way (at the same rate) as it increased. Display a completed table and graph of the data.
- How did the relationship show up in a table and graph? As the length increases, the area increases to a maximum point, and then it decreases in the same way (at the same rate) as it increased. The graph is a curve starting at the origin that increases until it reaches the maximum point. Then it decreases. The graph is symmetric with respect to a vertical line through the maximum point.

If needed, you may want to briefly review graphing in the first quadrant.

Launch: Presenting the Challenge

- Tell the class about bicycles and the yearly bicycle tour across Iowa. Encourage students to share other facts about organized bicycle tours they might know. Then continue reading about the bicycle trip that the five college students are planning. Have students share their ideas about the questions in the introduction. Students should justify their guesses about the distance they think they could ride in a day and consider ways in which their speed might vary throughout the day.

Suggested Questions

- How far do you think you could ride in a day? Answers will vary.
- How do you think the speed of your ride would change during the course of the day? Most students will indicate that their speed would slow down over the course of the day as they grew fatigued. Others might say that they could get surges of energy, especially toward the end.
- What conditions would affect the speed and distance you could ride? Answers might include the type of terrain (rocky or smooth); how much of the ride is uphill, downhill, or flat; weather conditions and temperature; and how much gear you carry.
- How are the cyclists' speed and distance likely to change throughout a day? Answers will vary.

After a short class discussion, move on to the jumping jacks stamina experiment. Connect the bike tour and the jumping-jack experiment

by pointing out that both activities involve physical exertion over a period of time. This experiment works best if students are divided into groups of four (five). Within the group, each student has a job: performing jumping jacks, counting jumps, timing when 10 seconds have passed, and recording the number of jumping jacks completed at the end of every 10 seconds for the 2-minute time period, and photo/video journalist to capture the experiment process digitally.

The directions suggest that students do jumping jacks for 2 minutes. If the time limit is too short (say, only 1 minute), then the jumping-jack rate is not as likely to change. Two minutes has worked well in many classes. We suggest that you tell students to talk to you if they are not physically able to do the experiment. Inform everyone that if they get tired they should stop. Every student does not need to jump. Many students like to volunteer.

You can show the Launch Video at this point, or have a group of four (five) students model the experiment in order to describe and clarify the roles of each person in the group. After describing the roles in the jumping-jack experiment, show this video to clarify the responsibilities for each member of the group.

Launch Video:

- Make sure students understand the emphasized points in Presenting the Challenge. Then, have them do the experiment.

Emphasize the following points:

- The jumper performs a complete jumping jack when he or she completes these three steps:
- Start with feet together and hands at sides.
- Jump, landing with legs apart and hands touching above the head.
- Jump again, returning to the starting position with feet together and hands at sides.
- The counter counts an additional jump each time the jumper returns to the starting position. The timer calls out "time" when each 10 seconds passes.The recorder listens for the timer to call "time" and then writes the last number the counter called into the table.
- Suggest that students make a table with the times from 10 seconds to 120 seconds, listed in 10-second intervals, before conducting the experiment. After the demonstration, give students copies of Labsheets 1.1A and 1.1B. Have students perform the experiment and then complete Problem 1.1. Have as many students as possible take a turn at each task. Remind them that they need to count and record the total number of jumping jacks their teammates complete by the end of each time interval.

Ask for some predictions about the jumping-jack stamina experiment:

- How many jumping jacks do you think you could complete in 2 minutes?
- How do you think your jumping-jack rate would change over the 2-minute test?

Explore – Providing for Individual Needs:

- When students have collected their jumping-jack data in a table, check in with each group as they produce their graphs using paper and pencil AND electronically to be sure they are plotting pairs correctly. Some students may need guidance in placing appropriate scales on the x- and y-axes for the graphs. Question C of the Problem asks students to interpret the pattern in the data and to be prepared to explain how that pattern is shown in each representation—table and graph.

Suggested Questions

- What patterns do you see in the graph? Explain. The total number of jumping jacks decreases. Because the number of jumping jacks in each interval decreases, the total decreases.
- Do the points lie on a straight line? No.
- What would it take to have the data points lie in a straight-line pattern? The jumper would have to jump the same number of jacks in each interval. This is unlikely to happen since the jumper will get tired and slow down.
- What pattern of growth do you observe between adjacent points? The number of jumping jacks per 10 seconds decreases as time goes by.

Summary:

- The core scientific issue in this Problem is how performance rates change over time. The core mathematical issue is how that performance rate pattern is shown by data expressed in tables and graphs. You can give focus to the Summarize discussion by asking students what their experiment told them about each issue.

Have students review the process of making a table to record data.
Suggested Questions

- The instructions told you to use 10-second intervals. Could you have chosen a different time interval for recording data in your table? Yes.
- Would your choice have affected your observations in Question B? If so, in what way? For smaller intervals the number of jumping jacks is lesser, and conversely, for larger intervals the number of jumping jacks is greater. However, the number in either case tends to decrease over time.

- What does the jumping-jack experiment suggest about bicycle-riding speed over time? Usually the rate decreases as time passes.
- Pick a point on one of the graphs and ask: What are its coordinates? Answers will vary.
- What information do the coordinates provide? The coordinates tell the number of jumping jacks for a given 10-second interval.
- Put up two or three graphs and ask: Which jumper has the fastest pace? Students can compare tables or compare ratios, 8 : 10 to 4 : 6. Or they can get a unit rate, 1:108 or 1:64, etc.
- Repeat some of the questions posed in the Explore.
- Compare the patterns in the graphs in Question E to those of your jumping jacks. The data points in Question E lie on a straight line. This is because they are doing the same number of jumping jacks in each interval. In the class experiment, unless the jumper's pace was steady, the pattern of points in a graph of the data will not be a straight line.

Proficiency:
When students have met expectations for this objective, they'll be able to construct a graph (by hand and using a web-based graping tool) from a table of data. They'll be able to describe the relationship between two variables (one variable is time) and explain how the relationship between the variables shows up in a table and graph. Proficiency can be evaluated by examining student's classwork, using an exit slip.

Feedback

Teachers As Learners:
In this lesson, data collection methods are quick and effective for students working in groups. Needs of visual learners addressed and students gain experience working with variables in the context of an experiment. Teacher can refer back to this lesson as a foundation throughout the remainder of the school year. One thing that might confuse students is the time recorded in seconds vs time displayed on digital time device so do time conversions with students prior to experiment (70 seconds on data table = 1min 10sec on timer) or have a master timer announce time intervals that match the labsheet.

Elements of Pretty Good Practices:
- Strategies that helped with the lesson's delivery:
- Teacher allows for exploration, while being there for support
- Video is a good attention getter; serves as a hook to the lesson
- Connection to science experiments, cross-curricular connections
- Good questioning and prompting to probe student thinking during the explore and summary portions of the lesson

Modifications and Adaptations

- Groups can be determined by students or assigned by the teacher
- Make Different size graph paper available (quad, cm)
- Different types of timing options … lab sheet table shows 2 minutes in seconds vs. a clock/timer display.for example, using 1 hr, 10 seconds or 70 seconds
- Vary the number of graphs required by hand and electronically for problem completion

Questions Arisen

- How will students share their create-a-graph with the teacher?
- Is there a local cycling group that you could connect with to show students this is an actual recreational activity? Possible field trip?

Peer Feedback

- Lesson is designed to launching student understand of variables and patterns of change. Introduce this lesson to students early and use real world relationships to reinforce connection to their environment and prior knowledge.

Bibliography:

- Lappan, Phillips, Fey, Friel, Variables and Patterns Connected Mathematics 3 2014

Related Resources/Ideas

- Getting Ready to Ride (Handout)
- Labsheet 1.1a
- Labsheet 1.1b

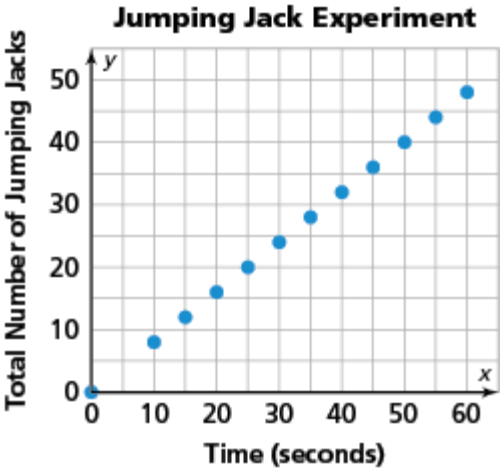
Teacher Resource: - ANSWERS Problem 1.1

- Student data will vary. In one class, several students started jumping at a rate of 10 jumping jacks for every 10 seconds. After 1 minute, they started to slow down slightly. Many had data entries of 107 and 108 jumping jacks for 120 seconds.
- Some students will have data that show their jumping-jack rate decreases as time passes. Even though the total number of jumps increases for each 10-second interval in the table, the rate decreases since the number of jumps in each 10-second interval decreases as time passes.
- The most likely pattern of jumping-jack data is greater numbers in the early 10-second intervals than in the later intervals. Since the directions ask students to record the total number of jumping jacks at the end of each 10-second interval (not the number during the preceding 10 seconds), the total will grow more rapidly at first than later. The difference between two adjacent table entries (divided by 10 to get a rate per second) will tell the rate of jumping jacks.
- On a graph, greater rates will be shown by bigger steps upward from one data point to the next.
- It seems likely that students will find that their rate of jumping jacks slows near the end of the experimental time period. The analogy to bike riding would suggest that the speed of riding will slow as the day wears on (though this might be changed by rest stops that refresh the cyclists).
- Note: The goal of this part of the Problem is to address the Common Core State Standards for Mathematics that asks students to construct rate tables and to find missing entries in such tables.
- If a student jumped at a steady pace of 8 jumping jacks for every 10 seconds, the table of sample time and jumps data would look like this:

Jumping Jack Experiment

Time (seconds)	0	10	15	20	25	30	35	40	45	50	55	60
Total Number of Jumping Jacks	0	8	12	16	20	24	28	32	36	40	44	48

A plot of the points corresponding to (time, jumping jack total) pairs in the table will produce a linear pattern with the points rising up 8 for every 10 over.

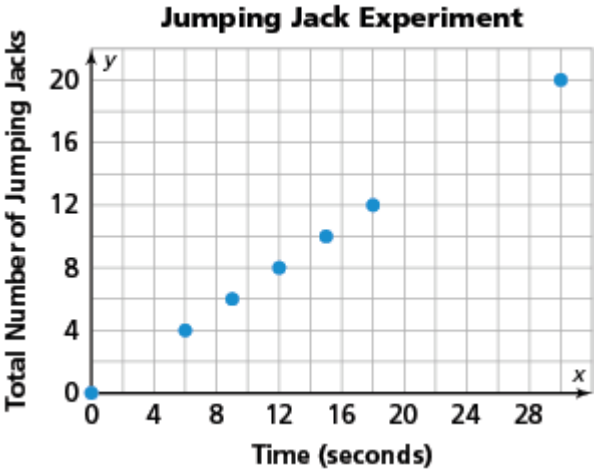


If a student jumped at a steady pace of 4 jumping jacks for every 6 seconds, the table of sample time and jumps data would look like this:

Jumping Jack Experiment

Time (seconds)	0	6	9	12	15	18	30
Total Number of Jumping Jacks	0	4	6	8	10	12	20

A plot of the points corresponding to (time, jumping jack total) numbers in the table of part (a) would produce a linear pattern with the points rising up 4 for every 6 over. As in part (1), it is a linear pattern except it is not as steep.



Chapter 20

Steven Mijajlovic: Solving Equations Using "The Blob"

Steven Mijajlovic earned a Bachelor of Arts in Accounting and Finance from Augustana College (Rock Island, IL). After his undergraduate degree, Steven went through an alternative teacher certification program partnered between Northwestern's NU-Teach program and the Chicago Teaching Fellows. He recently earned a Master of Science in Education with a focus in Secondary Mathematics Education at Northwestern University where Steven's research focused on mental math and pushing student thinking. Currently he is working on a Graduate Certificate in STEM Learning and Leadership through Michigan State University. Steven believes that modeling mathematics, in addition to inquiry and problem based learning is essential for student engagement and success in a mathematics classroom.

Solving Equations (One-, Two-, and Multi-Step Equations) Using "The Blob"

Grade Level: 7-9
Content Area Topic: Mathematics (Algebra)
Content Area Standard(s):

- CCSS.MATH.CONTENT.HSA.REI.A.1 Explain each step in solving a simple equation as following from the equality of numbers asserted at the previous step, starting from the assumption that the original equation has a solution. Construct a viable argument to justify a solution method.
- CCSS.MATH.CONTENT.HSA.REI.B.3 Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.
- CCSS.MATH.CONTENT.HSA.CED.A.1 Create equations and inequalities in one variable and use them to solve problems.
- CCSS.MATH.CONTENT.HSA.SSE.B.3 Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.

Learning Objective(s):

- Solve equations using properties of operations and the logic of preserving equality.
- Articulate the "common sense" behind rules of algebraic manipulations.
- Develop mathematical language related to calculations and equations.
- Developing a deeper understanding of what equations are by reinforcing number sense.

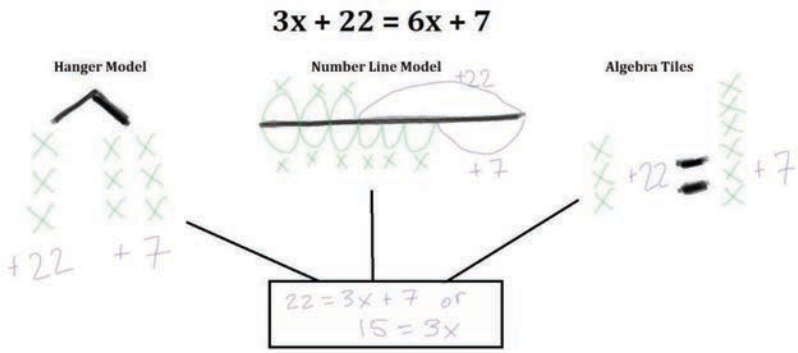
Suggested Time Allotment: Depending on the types of equations, 1-3 class periods (50 minutes)

Sequence in Learning:
Prior to this lesson, students will need a basic understanding of the number line and basic facts of arithmetic. Essentially meaning that students must understand the idea of opposite numbers equal zero, how to add and subtract positive and negative numbers, and multiplication rules/patterns (multiplying same signed numbers results in a positive solution and multiplying different signed numbers results in a negative solution).

Students are expected to be able recognize basic algebraic operations, which entails various ways that multiplication and division can be

represented (and). Additionally, students must understand the idea of equality – one side of the equation must equal, or be balanced, to the other side of the equation.

Lessons to follow this could be solving equations with variables on both sides of the equals sign. These types of equations can also be modeled using a hanger method to represent a balancing point, a number line model with "jumping" and "stepping," or algebra tiles. See pictures below of their respective models.



Materials & Resources Needed:
Video (http://smijaj.weebly.com/Blob.html); Table white boards; Play-doh (Optional for the Blob); Student handout – hand out attached.

Lesson Activities & Sequence:
Students will watch the video (http://smijaj.weebly.com/Blob.html) first of a two-step equation being solved using the Blob. They will individually answer the reflection questions at the top of the handout, then discuss with their table, and then we will share ideas as a class. At this point, the next three problems (examples 1, 2, and 3) will be done as a class, asking students what they think the appropriate steps are in order to go about solving the equations. The students will complete the last two problems (examples 4 and 5) as a table – students will be asked to put their work on their table white boards for both of the problems. After a given amount of time, students will hold up their boards and compare their solutions to the other groups. Some groups may be asked to present and share their work with the rest of the class.

Students will be homogenously grouped by ability. In my classroom, students are grouped according NWEA RIT band levels (< 210, 210 – 230, >230). Flexible group could also be used.

Proficiency:
A few checkpoints for a progression of understanding will be the discussion after the video (What do you think the purpose of the Blob is? And How do you know where to put the Blob?), the table white boards for examples 4 and 5, how the students are progressing through practice, and then the following day students will have a "Check In" (Homework quiz) on five problems of varying difficulty. This formative assessment can be differentiated by groups – different groups of students can be expected to solve varying levels of problems.

Successful responses can be measured at varying levels – students can be successful by identifying where to place the Blob, being able to explain why the placement of the Blob would work, being able to accurately solve an equation using the Blob, and for higher students, challenge them to solve equations using a mental Blob and showing no work.

Evaluation of these various formative assessments will mainly be based on accuracy. Most grading will occur on a 0 – 3 point scale: 0 is no work shown, 1 is little understanding, 2 is strong foundational understanding but some work still needs to be improved, and a 3 represents full understanding of the concept. If a student makes a small arithmetic error, however, has the premise of solving an equation, a 2 will be earned; a 3 can only be earned with no errors.

Feedback

Teachers As Learners:
Learners were continuously asked to explain their thinking when solving problems as a group, especially problems 1 through 3 which started the lesson off after the video. Learners are able to access the hand out virtually and use a tablet (if accessible) to work through the lesson. Some learners may also want to use a physical, tangible "Blob" (play-doh) to cover and uncover the unknowns as they work through the problems.

Elements of Pretty Good Practice:
Teacher started with discussion basic one step equations to get students thinking about solving for unknowns. Teacher asked learners to explain thinking or "how did you get that?" This prompts learners to understand the process of algebraic solving and also helps other learners possibly see a different problem solving technique. Teacher encouraged collaboration "turn to your elbow partner," teacher encouraged explanation "how did you get that?" and teacher modeled and encouraged multiple problem solving strategies.

Modifications and Adaptations

This lesson can be differentiated at various points of entry and through the practice problems. Higher groups could watch the video on the own, and work through the guided examples on their own, while the other levels of students watch the video and participate in the class discussion, then work through the guided examples with the class. Additionally, students can be supported according to their level and depending on their abilities. The differentiation of the assignment can also be taken into consideration, and different groups of students can be held accountable for different problem sets, or completing different amounts of problems at different levels.

Have the class name the blob, class color the blob, or color coding the blob for different levels or problems

Questions Arisen

- Contextual scenarios where students create equations then solve using the Blob
- Solving literal equations using the Blob – get the Blob alone this time
- How would you extend this to having students create their own "Blob" problem and recording on Educreations, apply to a physics problem (F=ma), or literal equation manipulation?

Peer Feedback

- Have student work through their own problem and ask their own questions (write them down)
- Have student make their own videos and teach the younger students – #QuickFire station make a lesson on the tablet
- Use play-doh as the Blob
- Silent video a plus!

Bibliography:

- http://www.corestandards.org/Math/Content/

Related Resources/Ideas

- http://www.educreations.com/lesson/view/using-the-blob-to-solve-a-two-step-equation/22907469/?ref=link
- http://ttalgebra.edc.org/
- http://www.worksheetworks.com/math/pre-algebra.html

Solving Equations Using the Blob Name _____

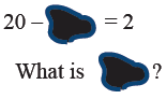
Watch the Blob!

What do you think the purpose of the Blob is? **How do you know where to put the Blob?**

Use "the Blob" to make sense of solving multi-step equations – for each of the following equations, use the Blob to cover up the pieces of the equation you are trying to solve for.

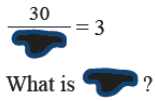
Then solve for the variable. Be sure to check your answer by plugging you solution back into the original equation.

Example 1: Check:



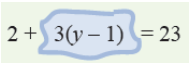
$$20 - 3p = 2$$

Example 2: Check:



$$\frac{30}{b+1} = 3$$

Example 3: Check:

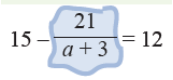


$$3(y-1) = \_\_\_\_$$

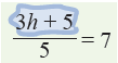
What is the Blob equal to? What should we Blob next?

Let's try these together…

Example 4: Check:



Example 5: Check:



Chapter 21

Sussan Oladipo: Turn Down the Heat: Exploring Thermal Insulation, from cookbook to inquiry

My name is Sussan Oladipo. I am currently an Assistant Principal at a Chicago Public School (CPS) on the South West of Chicago. I started teaching in CPS since 2000 and taught at CPS high school on the North of Chicago. I taught chemistry, Earth space, environmental science for seven years, Algebra (1year) before going into school administration. I was a school director for a charter school for one year and have worked at the CPS central office on a grant project. I have also worked at the CPS network office as an instructional support leader for nine CPS schools on the South of Chicago and currently work at my present role.

Turn Down the Heat: Exploring Thermal Insulation-from cookbook to inquiry

Grade Level: Grade 8 but this is also designed to support teacher teams who will teach the lesson
Content Area Topic: Science/Reading/Math

Content Area Standard(s):
- Ask questions to discover how energy moves WHST.6-8.7;
- Plan and carry out investigations to explore the movement of heat in a system WHST-8.2, MP.1;
- Obtain, evaluate and communicate information WHST.6-8.4, SL.6
- MS-PS3-4: Plan an investigation individually and collaboratively, and in the design: identify independent and dependent variables and controls, what tools are needed to do the gathering, how measurements will be recorded, and how many data are needed to support claim.
- CCSS.ELA-LITERACY.RST.6-8.3 Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.
- CCSS.ELA-LITERACY.RST.6-8.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 6-8 texts and topics.
- CCSS.ELA-LITERACY.W.8.9.B Apply grade 8 Reading standards to literary nonfiction (e.g., "Delineate and evaluate the argument and specific claims in a text, assessing whether the reasoning is sound and the evidence is relevant and sufficient; recognize when irrelevant evidence is introduced").
- CCSS.ELA-LITERACY.W.8.6 Use technology, including the Internet, to produce and publish writing and present the relationships between information and ideas efficiently as well as to interact and collaborate with others.
- CCSS.ELA-LITERACY.SL.8.1.C Pose questions that connect the ideas of several speakers and respond to others' questions and comments with relevant evidence, observations, and ideas.
- CCSS.ELA-LITERACY.RI.8.4 Determine the meaning of words and phrases as they are used in a text, including figurative, connotative, and technical meanings; analyse the impact of specific word choices on meaning and tone, including analogies or allusions to other texts.

Mathematical Practices
- Make sense of problems and persevere in solving them.
- Reason abstractly and quantitatively.

- Construct viable arguments and critique the reasoning of others.
- Model with mathematics.
- Use appropriate tools strategically.
- Attend to precision.
- Look for and make use of structure.
- Look for and express regularity in repeated reasoning.

Learning Objective(s):
- Apply science and engineering practices to our professional learning and daily classroom instruction;
- Engage, Explore, Explain, Elaborate and Evaluate using inquiry;
- Determine effective use of materials to support inquiry science.

Student Outcome Statements:
- Ask questions to discover how energy moves WHST.6-8.7
- Plan and carry out investigations to explore the movement of heat in a system WHST-8.2, MP.1
- Obtain, evaluate and communicate information WHST.6-8.4, SL.6

Suggested Time Allotment: 90 minutes or two periods of lesson

Sequence in Learning:
This 90-minute lesson is connected to a larger theme on the unit of Conservation of Energy and Energy Transfer. This addresses how thermal energy is transferred between objects or systems and how this concept affects our daily lives.

This is a lesson from a unit on energy, transfer of energy in form of Heat Transfer and will continue with lessons on different systems and impact of energy transfer.

Prior to this lesson, students need to have learned the various ways that energy moves from one higher-temperature object to another of a lower temperature, cooling the higher temperature object and heating the lower temperature object in the process.
Previous lesson in the unit would have explored concepts of conduction, convection, and radiation and how they are connected to students' everyday lives. Students would have also learned about science practices, including experiment design concepts such as independent, dependent variables, control variables, and scientific explanations.

Materials & Resources Needed:
A video clip on inquiry science link: https://www.youtube.com/watch?v=LJJoKxDsyoQ; Bill Nye's heat video URL: https://www.youtube.com/watch?v=j9GDDLwzpAY; Eight balls of cotton

wool per group; A piece of 5 by 5 bubble wrap per group; One thermometer per 2 students; One 4 by 4 inches fleece; Two cups of sand per group; One cup of hot water and cold water per group; One notebook journal per student; Writing materials (pen, pencils, rulers); Three paper- bowls per group; One small container per group, one laptop per group; Wordle.net website; One large post it per group; Two post its for creation of anchor charts; Website: readworks.org-Informational text titled A ball of Energy by Gabrielle Sierra; "Turn Down the Heat" Worksheet (Prentice Hall 1994, p. 483–85),

Lesson Activities & Sequence:

Students will be grouped heterogeneously in twos or threes.

- Students will read the informational text titled A Ball of Energy in their groups and answer the text- dependent questions in their journals.
- Students will watch a short video clip and decode meaning of vocabulary words from context of video. This video is the Bill Nye's heat video URL: https://www.youtube.com/watch?v=j9GDDLwzpAY
- They will answer questions on the experiment and reflect on the outcomes of the experiment. Students will answer the question: What have you learned doing this experiment?
- (For the teacher teams the video on inquiry will be watched and discussed.)
- Students will listen to video on the Promethean board and take notes of salient points in their individual science journals. Teacher will discuss new vocabularies from the video through driving questions

Teacher will engage student using driving questions about ways in which energy is transferred. Questions will include:

- What are the different ways that energy is transferred through solids, liquids and gases?
- What were the variables in our experiment?
- What variable did we manipulate?
- What was the responding variable?
- How did we ensure it was a fair test?
- How does the temperature change help us determine which material is the best insulator?
- Which material is the best insulator?
- Why is this material a better insulator than the others?
- Are good insulators also good conductors? Why or why not?

Students will be asked to record responses in their science journals. Teacher will walk around to ensure that student groups were on task and to gather points from what students were writing to be used as

teachable moments from what students were writing. Listening in on group discussions will afford teacher a means to formatively evaluate the students as they shared emerging ideas about conduction, convection and insulation.

The ideas that the students scripted in their journals will then be shared during a whole-group discussion. Discussion will be centered on how insulators affect student lives. For example, students will share how insulators are used in winter and how students can design an experiment to determine which materials are better insulators and which among the materials provided is the best insulator.

Teacher will lead students to plan and use the materials provided to conduct a simple experiment that would provide an explanation for the question they generated during the above discussion.

Teacher will ask the following questions to guide students in planning the experiment:

- What data would you collect to find out if a material is a good conductor?
- Would you record the time it took?
- Which other variables would you use in designing your experiment?
- How would you set up your control?

Students will then work in their groups to carry out the experiment. Teacher will circulate to provide needed help and to assist students in any way needed. Students will create data tables and graph their data of insulators and the temperature at which they are able to retain heat energy.

Proficiency:

When students have met expectations for the objectives, they demonstrate understanding of the scientific practices involved in the inquiry activity as well as the underlying core ideas in which the activity was based. This will be evaluated in the following ways:

- Students will be asked asked to represent the pooled data using a bar chart, where the x-axis represent the insulating materials and the y-axis represented the temperature change.
- Students will also required write a scientific explanation to convey their understanding of the results of the experiments
- The explanations will consist of a claim, which will be a student's understanding of the results of an investigation; the evidence from the data that supported the claim as well as the reasoning that goes with it.
- In addition, when students have met expectations, I will see evidence

of students asking questions from teacher and from peers to discover how energy moves. Questions may include why certain conductors are better than others. How people that live in very cold regions of the world conserve energy and insulate their homes.

- Other evidence of proficiency will be students' planning actively with their peers and carrying out investigations to determine which materials are better insulators from the different kinds of materials available.
- Other evidence are students' obtaining, evaluating and communicating information to their partners through speaking and active listening, writing when prompted by teacher.

Rubric

Elements	1	2	3	4
Journal	Journal has at least 1 word and its explanation from context.	Journal has at least 3 vocabularies and explanation of their meanings form context	Journal has at least 5 vocabularies and explanation of their meanings form context	Journal includes at least 7 vocabularies and explanation of meanings
Experiment design	Only one member of the group is generating questions and ideas about how the design should go	One third members of the group are generating questions and ideas about how the design should go	Two third of the group are generating questions and ideas about how the design should go	All members of the group are generating questions and ideas about how the design should go
Data and Graphic representation	Data table has only a few necessary parameters populated and graph is only partly labeled and scaled.	Data table has some necessary parameters populated and graph is somewhat clearly labeled and scaled.	Data table has most necessary parameters populated and graph is mostly clearly labeled and scaled.	Data table has all necessary parameters populated and graph is clearly labeled and scaled.
Writing of evidence	Written evidence has one or two claim, evidence and reasoning.	Written evidence has some (two or more) claim, evidence and reasoning.	Written evidence has most (three or more) claim, evidence and reasoning.	Written evidence has all (four or more) claim, evidence and reasoning.
Conclusion	Conclusion summarizes one findings and central idea behind objective	Conclusion summarizes two findings and central idea behind objective	Conclusion summarizes three findings and central idea behind objective	Conclusion summarizes four findings and central idea behind objectives

Feedback

Teachers As Learners:
- Video clip activated prior knowledge
- Video clip allowed students to clear misconceptions, review concepts, introduce new vocabulary words
- Supported visual learners
- Note taking was free format: Students could take notes any way they would like which appealed to multiple learning styles

Elements of Pretty Good Practice:
- Appealed to diverse learners: Kinesthetic, visual, interpersonal
- Visuals: Organized powerpoint
- Activate prior knowledge
- Evidence of thorough planning
- Inquiry based
- Integrated writing math, engineering, speaking standards
- Anchor charts
- Scaffolding the creation of data charts
- Consideration of ELL strategies: visuals, graphic organizers, vocabulary, drawing, audio support
- The use of the 5E model

Modifications and Adaptations
- Support students who lack perseverance with scaffolding: Ask questions, partner students with teacher leaders, provide guided lab sheet with open ended questions, allow conversation with other lab groups
- Special education: Differentiate the assignment to provide extensive time to build before experimentation
- ELLs: Front load vocabulary

Questions Arisen
- How can we integrate technology into instruction?
- How can we support students who lack perseverance?
- What are other ways to scaffold inquiry for ELLs and SPED students?

Peer Feedback
One major suggestion was to scaffold the lesson a multiple ways for the ELL students. However, since this is an inquiry lesson, students are supposed to discover by themselves by asking questions to inquire and discover the ideas, information and concepts embedded in the tasks, the level of scaffolding will vary with ability of the student group. An exception may be made to this strategy by me asking the students

more scaffolding questions to provide some clue to accommodate this suggestion (but on a case by case basis.)

Accommodation for Diverse Learners: Diverse learners will get extra time on task, repeated explanation of task and other accommodations indicated in their individualized learning plans.

There will be audio readings to differentiate for auditory learners and students who are ELLs.

Differentiation: Teacher will circulate, observe to formatively assess what each student are doing individually and in a group. If warranted, teacher will sit and support different groups, and leverage any teachable moments to further advance students skills individually and in groups.

Bibliography:

- Exploring Thermal Insulation by Cheryl A. McLaughlin
- Readworks.org: A ball of Energy http://www.readworks.org/sites/default/files/passages/1070_a_ball_of_energy.pdf
- Prentice Hall Science: "Turn Down the Heat" (Prentice Hall 1994, p. 483–85),
- Video clip by Bozeman –asking question series: https://www.youtube.com/watch?v=LJJoKxDsyoQ
- Exploring Thermal Insulation (PPT)

Chapter 22

Tasha Henderson: Acoustical Engineering: Representing Sound using Technology

S.T.E.M teacher for Chicago Public Schools. Tasha Henderson is a life-long learner and has a deep passion for the sciences and technology. Prior to her career in education she was a Senior Database Administrator for the Chicago Board of Trade for several years. She is a Chicago native and enjoys the downtown scenery and summer festivals. In her spare time she loves spending time with her family and attending events in theater, dance and music.

Acoustical Engineering: Representing Sound using Technology

Grade Level: Grades 3-5
Content Area Topic: Acoustical Engineering
Content Area Standard(s):
- CCSS: RI.3.1, RI.3.2, RI.3.3 NGSS:
- 3-5-ETS1-1. Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.
- 3-5-ETS1-2. Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.
- 3-5-ETS1-3. Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.

Learning Objective(s):
- Scientists and engineers often use representation of sound to study and communicate about them.
- There are many different ways to represent the same sound.
- Sounds are comprised of several different properties that can be expressed in various ways.
- Using representation systems are a type of technology.

Rationale:
- Work collaboratively to design a representation system for communicating the properties of sound using virtual instruments.
- Use the Engineering Design Process to creatively design and construct a new sound and musical track.
- Demonstrate that there are various ways to represent the same or different sounds.
- Evaluate: Ask, Imagine, Plan, Create, and Improve steps from Engineering Design Process to design and create their Garage Band Track representations.
- Articulate and explain with their partner presentations for their Garage Band Tracks

Suggested Time Allotment: 1-2 sessions; 60 minutes

Sequence in Learning:
Geography was used as an introduction to the Unit on drumming and how it's used in Africa as a means of communication.
Prior to this lesson students have studied the Engineering Design

Process in detail. Students have also learned the Acoustical Engineering occupation and visual representation of animal sounds. Following this lesson students will have a deeper understanding of using computer technology to compose a composition for their own song.

Materials & Resources Needed:
www.pbslearningmedia.org; MacBook Air Laptops, Garage Band, Do Now sheets, Exit Tickets, Assignment Task Card, and Garage Band Laboratory Sheets

Lesson Activities & Sequence:
Students will: 5-7 minutes

- DO Now: Considering we have been learning and creating various representations for sounds using our handmade materials. Can we use computer technology to create various representations of sound? Explain your answer.
- Teacher: Play the Acoustics video: "STEM Careers Acoustics Professor"
- Teacher: Explain, what does a representation system for sound means as seen in the video?

Teacher will: 10 minutes

- Review Do now answers with students and discuss their answers. After responses have been discussed teacher will introduce Garage Band application as another tool that can be used to represent sound virtually. Teacher will review the definition of technology and how technology is used. "Technology is almost anything created to solve a problem or meet a need."

Teacher and Students will: 5 minutes

- Teacher will scaffold the Garage Band application and guide students through the process to create a track and the various functions of the instruments. Explain the assignment expectation and pass out laboratory sheets and MacBook Air laptops.

Students will: 25 minuets

- In differentiated groups with heterogeneous groupings students will have team roles previously assigned. Diverse Learners will receive Form B and Tier 1 & Tier 2 will receive Form A.
- Students will work collaboratively with partners to design and construct their tracks using Garage Band application.

Teacher will:

- Did we use computer technology for a representation system? How did we you use it?

Lesson Review & Exit Ticket: 5 minutes

- Students will: Complete exit ticket question: How did the design and creation of your Garage Band track go? Do you plan to make improvements?

Proficiency:

- In order for the students to reach proficiency or mastery students must answer question 4 and question 5 with a thorough knowledge of the connection of: How would an Acoustical Engineer use the Garage Band application in their occupation?
- Laboratory sheets will be graded using a point value for each laboratory question and the Engineering Design Process. Total point is 16.

Feedback

Teachers As Learners:

Educator must be knowledgeable on using the Garage Band Application and use strategies to address the multiple intelligences through-out in the laboratory activity. Lesson made connections to all learners such as visual, tactile, kinesthetic, and definitely auditory. The visual representation of sound were all represented using this software. The activity was multi-sensory on all levels.

Connections made across various content areas was explored through-out the lesson. During the lesson teacher and students examined the Spectrogram and Waveforms in the application. This task includes discussing mathematics such as duration and positioning of the pitches.

There is an abundance of hands-on, interactive, lots of exploration, no barriers to their creativity and exploring. Good classroom management is essential to get students disciplined enough to stop using the application and transition to the next task. Procedures and routines need to be in place so every student has the same opportunity to use the design and test with the application. Prior lessons will strongly equip students with adequate prior knowledge to prepare for participation in the Garage Band activity.

Elements of Pretty Good Practice:

- Pedagogical strategies that made this lesson a success:
- Scaffold the use of the Garage Band Application
- Higher-Order and Critical thinking Activities through-out lesson
- Activating prior knowledge
- Cross-curricular laboratory tasks
- Directive instruction is characterized by a computer-based tutorial

where information is presented, the student responds, feedback is provided and this tutorial learning cycle is repeated.
- Guided Discovery is characterized by a Garage Band simulation that allowed the students to manipulate the application or environment.
- Exploratory instruction is characterized by an open learning environment in which the students was provided a rich, networked database of information, examples, demonstrations, and exercises from which the student can select whatever is appropriate to their current needs and mental models.

Modifications and Adaptations
- Create extended learning tasks for enrichment students – create full song with more instruments.

Questions Arisen
- How can this activity work as a "center" activity if your classroom does not have technology for every student or pair of students?
- How can we get a technology device for every student?

Peer Feedback
- Maybe extend classroom learning to visiting a live performance or recording music studio or other venues where acoustical design/ engineering is a key element

Bibliography:

- Martin, Jeannette, and Braden Chang. Sounds like Fun: Seeing Animal Sounds: Sound and Acoustical Engineering for Elementary Students. Boston: Museum of Science, 2006.
- PBSLearning Media Video. PBS. 1990. The Pennsylvania State University. 1990 Video Streaming.

Related Resources/Ideas
- Attached: Garage Band Laboratory Sheet; Garage Band Task Card; Do Now Sheet/ Exit Ticket

NAME_____
DATE_____ Room_____
*** Please complete your lab sheet using complete sentences. ***
Remember: Acoustical Engineers design many different technologies and systems having to do with sound.

1. What type of music did you and you partner select? Explain why the two of you selected this type of music? Worth 2pts

2. Do you hear certain instruments in the music you have selected? What are they? Worth 3pts

3. List at least 5 different instruments that are listed in your Garage Band application?
Worth 5 pts
1. _____
2. _____
3. _____
4. _____
5. _____

4. How might an Acoustical Engineer use the Garage Band application to perform their job? Why? Worth 2pts

5. How would an Acoustical Engineer use the Engineering Design Process with the Garage Band application? Explain. Worth 2pts

6. Sketch a drawing of your favorite instrument used in the Garage Band application. Worth 2pts

NAME_____
DATE_____ Room_____
*** Please complete your lab sheet using complete sentences. ***
Remember: Acoustical Engineers design many different technologies and systems having to do with sound.
What type of music did you and you partner select? Explain why the two of you selected this type of music? Worth 2pts

Do you hear certain instruments in the music you have selected? What are they? Worth 3pts

3. List at least 5 different instruments that are listed in your Garage Band application?
Worth 5 pts
1. _____
2. _____
3. _____
4. _____
5. _____
6. Sketch a drawing of your favorite instrument used in the Garage Band application. Worth 2pts

Acoustical Engineer: Creating Garage Band Tracks

NAME_____ DATE_____

Logon to Garage Band
Select New Project
Create your own File
Select Loops
Create your own beats by clicking and dragging selected instruments

USE COMPLETE SENTENCES
What instruments did you select?
Explain why did you choose these instruments?
What did you do to improve the sound of your track? Explain
How would an acoustical engineer use the Loop options for Garage Band? Use the back side

Chapter 23

Angelica Tobias: The Engineering Design Process and The 3 Little Pigs

I am a life long learner who just happens to be an educator! I have been a teacher for four years in the Chicago Public Schools. I just became the Science and Engineering Coach for Marvin Camras Children's Engineering school and am excited to support our amazing and hard working teachers! Go Team! My passion is STEM education, specifically in engineering since in my "previous career life" I was an electrical engineer. I literally see engineering everywhere! I'm so bad, that I collect (clean!) toilet paper tubes and other recyclables for future engineering projects! :-) I also coach our after school LEGO Robotics club and engineering club. In my spare time (ha!), I like to collect toilet paper tubes.

The Engineering Design Process and The 3 Little Pigs

Grade Level: 1st - 2nd grade
Content Area Topic: Engineering
Content Area Standard(s):
NGSS:
- K-2-ETS1-1 Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a need or improved object or tool.
- 2-PS1-2 Analyze data obtained from testing different materials to determine which materials have the properties that are best suited for an intended purpose.

CCSS:
- R1.2.1 Ask and answer questions as who, what, where, when, why and how to demonstrate understanding of the key details in text.
- W.2.7 Participate in shared research and writing projects (e.g. read a number of books on a single topic to produce a report; record science observations).

Learning Objective(s):
- Objective is to use the Engineering Design Process and apply it to a simple children's folklore story.

The Engineering Design Process has 4 steps:
- Think – Ask: "What is the problem?" Imagine: "Think of many different ideas to solve the problem."
- Plan – Draw your best idea, which solves the problem. Label and write the materials needed.
- Create – Build your idea!
- Improve – Test it! Did it work? Start again to make it better!

Learning Target – I Can use the Engineering Design Process to solve a problem.

Suggested Time Allotment: Two (2) to Three (3), 40 minute periods

Sequence in Learning:
This lesson is from my Folklore and Engineering Unit. It integrates literacy and engineering and it's objective is to make the engineering process accessible for younger students. Before this lesson, students would have been taught the Engineering Design Process and would already have the prior knowledge of the process. The 3 Little Pigs EDP lesson is part of a series of Folklore EDP lessons and can be used

by it self or with the other lessons. Completion of this lesson will help students gain experience in applying the Engineering Design Process in other contexts.

Note: The Engineering Design Process is modified from the Elementary is Engineering Design Process, which has 5 steps (Ask, Imagine, Plan, Create, Improve). This EDP was modified for 1st – 2nd grade students by merging the Ask and Imagine step into the Think step.

Materials & Resources Needed:
The 3 Little Pigs book by Paul Galdone; Post –It Notes; Engineering Design Process Graphic Organizer, Poster Chart paper for shared thinking of EDP solutions; Markers, Pencils, paper, crayons; LEGO bricks; Straw, sticks, bricks

Vocabulary: Engineer – someone who uses math and science to solve a problem; Engineering Design Process – Think, Plan, Create, and Improve; Straw; Sticks; Bricks; Compare – How are they the same?; Contrast – How are they different?

Lesson Activities & Sequence:
Teacher will have Engineering Design Process organizer up and visible. Teacher will review the Engineering Design Process (EDP) with the EDP anchor chart that details the 4 steps in the process. Teacher will review that engineers use the EDP to solve problems.

Teacher will explicitly tell children their learning targets for this lesson. Teacher will ask students (Ss) if they know the 3 Little Pigs story. Teacher will read the 3 Little Pigs story and pause at different places to make predictions and ensure understanding. Teacher should have the straw, sticks, and bricks out for students for a visual aid.

Example of some guiding questions:
- What material did the 1st/2nd/3rd little pigs use to build his house?
- Do you think it is a good material to use? Why/why not?
- What do you think will happen when the wolf blows the house of the 1st/2nd/3rd little pig?
- What was the 1st/2nd/3rd little pig's problem?

Retelling – Teacher will ask students to retell the story. Students can retell by 1) verbally telling the story, 2) Writing down their retelling, 3) Drawing down their retelling or 4) Using the LEGOS to retell.
Teacher will assess the retelling of the story.

Teacher will explain to students that they will now apply the EDP to solve the little pigs' problem. Teacher will pass out Post It notes and tell students that they will use the Post It notes for the EDP and that they should write their names on every Post It note they use.

THINK — (Ask) Teacher will ask students to identify the problem that the little pigs had, and fill out a Post It identifying the problem either through words or pictures and post it under the THINK step in the EDP graphic organizer. Remind students to write their names for formative assessment purposes.

(Imagine) Teacher will ask students to think of many different solutions to solve the pigs' problem. All ideas should be encouraged and written down! Ss will fill out a Post It with their ideas (solutions) and post it under the Think step of the EDP graphic organizer.

PLAN – Teacher will now ask students to pick out their best idea (solution). Ss will post their best idea under the Plan step of the EDP graphic organizer. Students will draw their solution on the Post It note. Teacher should emphasize to students to label their drawing.

CREATE – Teacher will explain to students that this is the "Built It" step!. Students will now build their design with LEGOs. Ss will present and explain their prototype/model to the class. Teacher will set presentation norms/expectations. Students will then use a Post It note to write what they think the best or worst part was in their creating the model. Students will then post it under the Create step in the EDP graphic organizer.

IMPROVE – Students will test the strength of their design. Teacher will guide students to determine test criteria. Students will use a Post It note to write down if their design worked and if they need to improve it. Students will then post it under the Improve step in the EDP graphic organizer. Students can make changes to their design after testing so they can improve their design by cycling back through the Engineering Design Process.

Note: Because Legos are interlocking and will withstand any pressure or fan, most designs will work. Teacher can still use the improve stage to ask students to add or change their design after some design reflection.

Proficiency:

- Below are the multiple methods to assess whether students have met the objective.
- Retelling – Verbal, written, drawn, modeling with LEGO props

- EDP Graphic organizer – Students are able to write down and post their ideas correctly on the EDP graphic organizer. See rubric below.
- EDP - Students will be able to identify what step they are in the Engineering Design Process as they are working through the investigation.
- House Design – drawn plan
- Prototype Project – built LEGO model (Performance Task)
- Oral – Students will be able to present their solution and explain their design and why they chose certain features of their design.

Engineering Design Process Rubric:

EDP Step	3 Proficient	2 Basic	1 Emerging
Think	Writes that problem was, the little pigs' houses were not strong enough (or similar) And has at least 3 – 4 solutions.	Writes that problem was the little pigs' houses were not strong enough Or has at least 2 solutions.	Skips step or writes only one solution.
Plan	Draws and labels the best solution clearly	Draws or writes the best solution	Either no solution drawn or can not explain soluion
Create	Builds model and can describe 3 to 4 features of their design.	Builds model and can describe 1 to 2 features of their design.	Builds model
Improve	Writes down if their design worked AND what they need to improve.	Writes down if their design worked OR what they need to improve.	Writes a simple yes or no

Extensions:
- Math Integration – How many LEGOs?
- Literacy Integration – Story writing, retelling
- Additional – Read different versions of the 3 Little Pigs. Compare/ Contrast the different versions.

Feedback

Teachers As Learners:
- What worked was the literary connection and applying the concept of the engineering design process in the Three Little Pigs. They also liked the emphasis on imagination and "anything goes".
- My colleagues suggested that I provide visuals by putting pictures of the text on the EDP Anchor Chart.
- My colleagues liked the shared reading and the student friendly text. They also thought it was a good balance of technical language.

Elements of Pretty Good Practice:

- Integrated Instruction: Literacy read aloud reinforces fluency, and engaged students through voices.
- Teacher circulated and provided feedback.
- Conversation: There was plenty of student-to-student discourse and Teacher-to-Student discourse.
- Assessment: Post Its were used as an assessment tool. The performance task of designing a better house was created from the viewpoint as Jr. Engineers so it was a different vantage point than the student point.
- Interactive Anchor Charts: Graphic organizer was created collaboratively with students. The engineering discipline was used for a performance task.

Modifications and Adaptations

- Use highlighter to follow along while you are reading.
- Bring the materials of straw, sticks, and bricks.
- Have students experience the "huff and puff" by bringing in a fan.
- Integrate atomic structure ("everything starts with atoms/molecules/matter) to previous lessons.
- Use a video clip of the story, for example, www.speakaboo.com

Adaptations:

- Conflict resolution in other fairy tales: Humpty Dumpty, Cinderella, etc.
- Listen to the story before the shared reading in students' native language.
- Add non-linguistic representations to accompany steps of the engineering design process.
- Performance Task: Rewrite the favorite fairy tale integrating examples of energy.

Questions Arisen

- How do you keep track of the Post It notes? I have students write their names and then I take a snapshot of the completed EDP graphic organizer.
- How long does the lesson normally take? The lesson takes about 2 to 3 days.

Related Resources/Ideas

- Other books that can be used for the 3 Little Pigs are:
- The Three Little Wolves and the Big Bad Pig, by Eugena Trivizas
- The Three Little Javelinas, by Susan Lowell
- The True Story of the 3 Little Pigs! by Jon Scieszka
- Other engineering design lessons for the 3 Little Pigs are:

- The Three Little Pig Design Challenge Webquest: http://www.protopage.com/dakstem#Untitled/First
- Engineering for the Three Little Pigs: http://www.teachengineering.org/view_activity.php?url=collection/cub_/activities/cub_earth/cub_earth_lesson1_activity1.xml

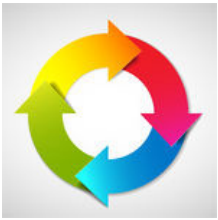
Engineering Design Process (Modified for 1st-2nd grade)

Visual Representation for Process:


THINK


CREATE


PLAN


IMPROVE

Engineering Design Process Graphic Organizer

THINK	PLAN
CREATE	IMPROVE

Chapter 24

William Campillo: Writing Linear Functions to Predict Expenses

I worked as a graphic artist for several years before changing careers. I originally used my knowledge of the graphic arts to work with teachers and schools around publishing student work. This led to a chance encounter with an alternative certification program in middle grade mathematics. Since then I have taught mathematics and recently added certification in middle grade science.

A course in environmental science changed my outlook and refocused my purpose as an educator. Since then I have tried to integrate themes into my teaching that touch on such issues as our local ecosystem, alternative energy sources, urban farming, climate change, population growth and natural resources. I am currently coordinating an International Baccalaureate program in a Chicago Public School with the goal of spreading these same themes throughout the school.

Writing Linear Functions to Predict Expenses

Grade Level: 8th or 9th
Content Area Topic: Mathematics
Content Area Standard(s):

- CCSS.MATH.CONTENT.8.F.B.4 Construct a function to model a linear relationship between two quantities. Determine the rate of change and initial value of the function from a description of a relationship or from two (x, y) values, including reading these from a table or from a graph.

Learning Objective(s):
Create a linear function from a real world relationship between variables (number of units used vs. cost of those units) to determine cost of an item or a service.

Suggested Time Allotment: 1 hour

Sequence in Learning:
The unit inquiry statement suggests that important personal economic decisions can be made with the help of linear functions. A general introduction to functions and practice with simple linear functions has occurred in previous lessons. The warm up problem is a review of these ideas and leads up to the lesson. After this lesson, students will continue to work with linear functions that can be used to predict most expenses for their family. The goal will be to combine functions for average monthly expense that will help to determine what is the minimum income needed to cover support the typical household from their community.

Materials & Resources Needed:
Student instructions for activity are on last pages of this document. They can use calculators to help find answers that involve computing fractional percentages. When student continue with the second part of the lesson they will use links to the websites for power and natural gas providers (Commonwealth Edison and People's Gas). These websites, explain how the monthly bills are calculated. Students will use this information to write functions that will compute cost of using these utilities for any number of units.

Lesson Activities & Sequence:
Students will review creating functions from a description of a relationship between variables. A discussion of the warm up problem connects back to the context of the big ideas of the unit – What is a living wage?

First students will work together to practice creating a function involving purchasing an item with sales tax. With this modeling, students are guided to the second part of the task - writing a function to express the cost of using electrical and gas service.

There are two parts to this stage – one is to write the function, the other is to determine how many units will be used based on the relative size of the space and the number of people using the space. The second part is an extension that involves measurement of living space, an assessment of power usage, and other variables which may factor into the cost. A significant amount of research will be necessary to determine how much the cost should be. This will require a group effort and extended time searching the internet .

Proficiency:
Students will write and explain the parts of their linear function. They will use this function to calculate the costs for an item purchased in Illinois with sales tax included, or for extended learning, they will write a function to compute the cost of a utility given number of therms or Kilowatt hours (units used to determine amount of gas or electricity that has been used).

Feedback

Teachers As Learners:
Teachers who participated in this lesson thought the introduction was powerful in that the real life problem engaged students in a powerful way. The resources were effective additions to the lesson. The warmup combined with introduction helped to support the learner in approaching the problem. The unit has connections to a number of issues many students will face in the near future.

Elements of Pretty Good Practice:
The lesson includes modeling and activation of prior knowledge as well as extensions for advanced students. The context of the lesson is familiar to students and creates a connection to student knowledge. There is also a cross curricular connection to humanities, labor history (an 8th grade topic), and current events. Reading is also an important aspect of the lesson that can be integrated across curriculum. The lesson, as part of a longer unit, also contributes to students' consumer education.

Modifications and Adaptations
- The lesson can be designed as a cooperative learning experience, allowing for all skill levels to participate.

- The general concept can be applied to a number of different contexts allowing students to solve problems to different situations that arise in daily life
- The resource materials can be adapted to different levels of literacy or languages.

Questions Arisen
- How would you address the use of technology?
- When to make the decision to use paper-pencil as opposed to a calculator?

Peer Feedback
- The exploration part of the lesson may require more time or support. This can happen in a number of ways including teacher guidance, additional examples, scaffolding toward the more complex computation. The lesson can also be broken into two or more lessons to help reach the objective

Related Resources/Ideas
- Bellringer: Pablo is very happy that he found a job at Dunkin Donuts. He was offered $8.50 an hour and told that he would be scheduled to work 30 hours per week. Now that he has a job he wants to move out of his house. He has been looking at an apartment for rent in the neighborhood, but he is not sure if he can afford the $800 per month rent. Can you help him decide?

Utilities calculators
- http://www.allconnect.com/lp-gas/natural-gas-usage-calculator.html
- http://www.kylesconverter.com/energy,-work,-and-heat/therms-%28u.s.%29-to-cubic-feet-of-natural-gas

Minimum wage info
- http://www.chicagotribune.com/business/ct-minimum-wage-chicago-0713-biz-20140713,0,3556102.story
- http://www.dol.gov/whd/minwage/america.htm
- http://www.minimumwage.com/in-your-state/
- http://business.time.com/2014/02/28/an-animated-history-of-the-minimum-wage/
- http://www.dol.gov/whd/

Comparing corporate profits
- http://www.nytimes.com/2014/04/05/business/economy/corporate-profits-grow-ever-larger-as-slice-of-economy-as-wages-slide.html

- http://www.huffingtonpost.com/2013/10/01/real-wages-down_n_4023869.html

Videos
- http://business.time.com/2013/08/29/fast-food-companies-can-afford-to-pay-their-workers-more/
- http://thinkprogress.org/economy/2014/04/11/3425609/walmart-prices-food-stamps/
- http://www.youtube.com/watch?v=vAcaeLmybCY
- http://chicago.cbslocal.com/2014/05/15/chicago-fast-food-workers-part-of-global-protest/
- http://www.theguardian.com/world/video/2013/dec/06/chicago-fast-food-strike-minimum-wage-video

What is the cost of living? (Part 2 of 3)
We have been using linear functions to calculate costs for services and purchases of different types of items. What does this have to do with a minimum wage? If we look at some of the expenses that provide us with the basic services we all need, then we can determine how much money we must earn to be able to pay all of those expenses on a monthly basis.

We will use a function to calculate the cost of a typical item you might purchase at any store.. You want to buy a pack of gum. You want a big pack that will last a few days.

This box of gum costs only $9.99 But that won't be the amount you pay. Why not? Use the link below to find more information.
http://www.sale-tax.com/Illinois What will the total cost be?
Talk with your group and decide on a function for cost C(x) where x represents any item you want to purchase.
Write your function below.
C(x) = _____

Calculating the cost of Utilities

Let us get back to the topic of living expenses. Two major expenses that we must cover are electricity and natural gas.

Break up into pairs, then decide which pair will work on electricity cost and which will work on natural gas costs. Use the resources below to write a function that will calculate the cost of electricity or gas.

Extension: Go back to the warm up problem and decide if Pablo can still live on his own.

Chapter 25

Zarina Qadir: Seasoning The Seasons

My name is Zarina Qadir and teach in Chicago Public Schools system. I believe each child in an unique individual who needs a secure, caring, stimulating environment in which he or she can grow emotionally, intellectually, physically, and socially.

Seasoning The Seasons: Weather! Look,See and Do

Grade Level: 2nd
Content Area Topic: Science and Math
Content Area Standard(s):

- Draw a picture graph and a bar graph (with single-unit scale) to represent a data set with up to four categories. Solve simple put-together, take-apart, and compare problems1 using information presented in a bar graph.
- CCSS.Math.Content.2NBT.6 Add up to four two-digit numbers using strategies based on place value and properties of operations
- Know and apply the concepts, principles and processes of scientific inquiry.
- 11.A.1b Develop questions on scientific topics.
- 11.A.1c Collect data for investigations using measuring instruments and technologies

Objectives:

- Students will make predictions and confirm their predictions by completing the graphic organizer on temperature. Students will also compute the difference between the predicted and actual temperature.
- Students will also use bar graph and line graph to interpret data.

Suggested Time Allotment: This unit lasted for 6 weeks but was modified for a lesson 45 minutes.

Sequence in Learning:

- This is a lesson from a unit I completed with my students on the seasons and weather.

Materials & Resources Needed:
Graphics organizers, trade books on weather, books on different weather such as winter, summer, laptop, LCD projector, Almo, library resources and Safari Montage and home connections and Newspaper.

Review, vocabulary:

Sun		
Sunny	Rain	Meteorologist
Cloud	Rainy	Hot
Cloudy	Snow	Cold
Win	Snow	Cool
Windy	Fog	Warm
Thermometer	Foggy	Umbrella
Temperature	Humid	Puddle

Whole class discussion: Students will sit with the teacher on the rug and have discussion on the following questions. This activity was done in winter. It could be applied in any weather. Students will be given 5 mints to discuss with their neighbor and come back as a whole to discuss and teacher will write their responses on the board.

- Ask children to talk about what weather is like. How does it feel when they go outside? What does the sky look like? Make a list on the chalkboard of children's responses.
- Invite children to glance out the classroom window, then brainstorm a flurry of weather words together. Write children's responses on the chalkboard. If children run out of responses prompt them with some of the words in the list.
- Ask children which words have to do with weather?
- Have children circle those words on the chalkboard.
- Ask them to explain their reason for choosing the word.
- Ask them to:
- Tell about favorite things you do in their favorite weather.
- Tell about a time you were in a storm.
- How does weather affect us?
- How do we change the way we do things because of the weather?
- What are the weather systems that we experience in Chicago?
- How can you remain safe during a severe storm?

Lesson Activities & Sequence

- Students will use the graphic organizer to write their predictions on the weather/temperature chart for the week. Every morning one of the students was to act as a Meteorologist and report the accurate weather/temperature to the class.
- Teacher then will display weather forecast on the computer using LCD projector. Students will write the weather/temperature on their graphic organizer and check their predictions. They will also compute their difference and accuracy on their paper.
- Students will then graph their predicted and actual temperature and compare the two line and bar graph.

Proficiency:

- Students' participation and performance task will be the big key to inform me how successful the lesson was.

Assessment:

- Rubric for self-assessment which includes:
- Did I correctly complete the weather graphic organize?
- Did I show my work on how I got my answer?
- Did I correctly identify the prediction temperature and accurate temperature?

Feedback

Teachers As Learners:

- Learners asked clarifying questions
- Learners did not have a clear idea of the lesson objective. Learners were unclear of what they should accomplish.

Elements of Pretty Good Practice:

- Teacher considered students backgrounds when developing questions about weather.
- Teacher prompted vocabulary learned in previous lessons to start new lesson
- Teacher used differentiated instruction.

Modifications and Adaptations

- Adapt "Weather Prediction" template to clearly differentiate "weather" from "temperature"

Extended Activities:

- Students will role-play being a Meteorologist. They will have to get information own their own reading the newspaper, listening to the news to report to the class.
- Students will compare and contrast the weather and activities they can do in different weathers. They will gather information and use the Venn diagram to compare and contrast and share it with the class.
- Students will create a weather instrument and write about it how it will be used.

Peer Feedback

- Explicitly explain the lesson objective. Keep a single goal in mind and avoid going off on too many tangents. Provide an opportunity to practice vocabulary with other students

Name:_____

Weekly Weather Chart Weather Prediction

Actual Weather

Day	Date		Temperature	Day	Day	Day	

Roots of STEM

A collection of lesson plans, for teachers, by teachers

STEM educators in the Chicago Public Schools wrote this book. These innovative educators are all members of the MSU-Wipro STEM & Leadership Teaching Fellowship program.

The MSU-Wipro Fellowship is an innovative partnership between the nationally ranked College of Education at Michigan State University, global tech giant Wipro, and Chicago Public Schools. This partnership seeks to empower math and science teachers in Chicago Public Schools to create transformative, innovative, and multi-modal instructional experiences for students.

The first 25 MSU-Wipro Fellows were selected from an extremely competitive field of applicants to participate in this innovative, year-long graduate certificate experience aimed at building STEM teachers' capacity to lead and inspire innovative practices in urban K-12 schools. Participants demonstrated commitment to teaching in urban schools, deep knowledge of content, and evidence of promise within the field.

While this book is primarily geared towards K-12 educators in the STEM fields, it offers ideas for teachers across disciplines. This book is a unique resource for all educators.

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