Why is it Moving? Force and Motion for Kindergarten

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This curriculum unit is recommended for:
Kindergarten Science

Keywords: force, motion, friction, Newton's Laws of Motion, mass, push, pull

Teaching Standards: See Appendix 1 for teaching standards addressed in this unit.

Synopsis:

Kindergarten students love to make things move, whether it is toy cars or kicking balls while playing soccer. This curriculum unit explores the topics of force and motion while bringing it down to a Kindergartner's understanding. Students will study force and motion by completing labs with different sized outdoor balls and carts with different weights. The students will not be given much information about how to complete the labs, but will be given a chance to figure out on their own how they want to answer certain questions that I will be asking throughout the experiments. Throughout the unit, the students will be recording all their thoughts and findings in a science journal.

I plan to teach this unit during the coming year in to 20 students in Kindergarten Science.
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Melanie Ann Kirschner

Introduction

I teach Kindergarten and First Grade at Albemarle Road Elementary School in the Charlotte-Mecklenburg School system (CMS). CMS is one of the largest school districts in the country and has received recognition as being one of America's best.[1] We are a Title-1, Pre-K through 5th grade school with approximately 1500 students. Of those 1500 students, 96% qualify for free and reduced meals. Our population is very diverse, with approximately 44% Hispanic, 42% African American, 5% White and 8% Asian. Also, approximately half of the 1500 students are limited English proficient, which means that they speak another language in the home. Spanish is the language that is predominately spoken, but there are many other languages that can be found in my school. We also have a growing refugee population with students from strife-affected areas such as Sudan, Congo, Liberia, Somalia, Eritrea, Ethiopia, Nepal, Bhutan, Burma and El Salvador.

My classroom currently consists of 18 Kindergarten students and 20 First Grade students (we have a highly mobile population with families moving in out of our area apartment complexes and my classroom numbers could fluctuate). Twelve of my 18 Kindergarten students are ESL, English as a Second Language, and fourteen of my 20 First Grade students are ESL as well. The majority of those students come from families that speak Spanish, but there are a handful of students that are from Asian countries like Myanmar. Due to the fact that the majority of my students speak another language; it makes it hard to communicate with their parents. Since my school has many staff members on hand that speak Spanish, it makes it easier to communicate with those families since we send home translated handouts and notices every time we send something home and make phone calls as necessary. This year, we have some access to a translator line that can help us contact parents who speak languages other than Spanish. We are able to call a number and contact a translator who then calls the parent to have a conference call. This way, I am able to inform parents, in their own language, of their student's progress or of any concerns I may have.

Rationale:

I decided to make my unit on force and motion because it is a topic that will be touched upon again and again throughout students' school careers. By teaching this subject to Kindergartners and possibly First graders, it gives them prior knowledge so that when they see this topic again later in their educational career they can be successful. In this day and age, science is a subject that is sorely lacking in a lot of schools. However, students still need to be able to pass the Science End of Grade test in fifth grade, but if they never have science, they are behind in knowledge and it makes it so much harder to catch up. By pre-teaching some material that you may think is too hard for Kindergartners, it gives them a base to pull knowledge from so that when they see it again, it is now familiar information instead of unfamiliar.

Force and motion affects us all every day. Things, even people, cannot move without a force acting upon them. The size of the push or pull on an object determines how fast and far it will move. Kindergarten students can understand that things move, but not how things move. They may be able to say that the shopping cart moves, but may not make the connection that they have to give it a push (a force) to make it move. They also cannot make the connection that things stop moving when another force is acted upon it (friction). I can push the shopping cart and if I no longer push it, it will eventually stop. I also want my students to realize that the heavier things are (more mass), it will take more of a force to make them move.

Objectives/Standards

The goal I have for this unit is to have my students understand what force and motion is. I want them to know that forces are what make things move. I also want them to understand that there are many different factors that affect how things move, like mass and friction. I want my students to make the correlation that the heavier things are, the more force it will take to make it move.

In order to teach force and motion, we will be reading some books on force and motion as well as have many others available to my students so that they may reference them on their own. These types of books are Informational Texts, which my students may not be as familiar with. It gives them a chance to interact with books that are telling them new information, not just entertaining them with a story. Not only can we read in books, there is a very informative website called PHET that I can guide my students through. There is a lot of information and illustrations that are on their level.

We will also be conducting some experiments throughout this unit. In the course of completing the labs, there will be a lot of discussion and talking with partners for my students. Speaking and listening is a very big part of the Common Core and it is necessary to be able to speak in complete sentences as well as be able to hold a conversation with another person. By letting my students, for the most part, take the lead in their learning; they will be able to practice talking to their peers. Since this is a science unit, they will also be using scientific vocabulary in their conversations.

My students will also be covering writing Common Core standards by writing in their science journals. They will be practicing sounding out words and writing in complete sentences by this time. Since they are reading informative texts, they will be able to write their own informative texts. They will be able to tell their writing audience what they did during the experiment and the results of that experiment.

Scientific Content: Overview for Teachers

In order to teach this lesson, you should become better acquainted with Newton's three laws of motion, which will help you to understand the goals of this unit. Newton presented his ideas about force and motion in the "Principia Mathematica Philosophiae Naturalis" in 1686.[2] These laws explain why things move and what causes them to move.

Forces are the things that make things move. A force is a push or pull upon an object. When I visit the grocery store and look at a shopping cart, I am not interacting with it, therefore it will not move. If I put my hands on the cart, I am intending to push it to where I need it, therefore I am now interacting with the cart and making it move. When it is where I need it, I will no longer interact with the cart and it will no longer move.

Newton's first law of motion talks about how things move when something acts upon it (a force). If no force is applied to an object, then it will not move. If I have a ball that is sitting on the floor, it is not going to move anywhere unless I walk over to the ball and kick it. After kicking it, the ball will move forward. This first law also says that if something is moving, it will continue to move unless a force makes it stop. For example, a ball rolling across the floor stops rolling because friction (a force) is acting on the ball.

Newton's second law of motion states that how fast something speeds up (accelerates) depends on how big a force was exerted on it. If I give my ball a little kick with not a lot

of force, my ball is not going to go very fast or far. On the other hand, if I kick my ball as hard as I can, it will go a lot farther than the ball with the little kick. It is under this law that if you have taken physics previously, you may be aware of the formula F = ma. F is the force and it is equal to the mass (m) times acceleration (a). However, during the course of this unit, we will not need to use this formula, but we will be working with heavier objects and your students should be able to make the connection that the heavier the object, the more force is needed to move the object.

Newton's third law of motion states that "for every action, there is an equal and opposite re-action."[3] What this means is that every time a force acts upon an object, there is an equal force that is pushing back on the object. So when I kick a ball, my leg pushes on the ball and the ball pushes back on my leg with the same amount of force.

Teaching Strategies

Socratic Seminar

Socratic Seminar, as defined, is "a collaborative, intellectual dialogue facilitated with open-ended questions about a text".[4] The teacher, since they are in Kindergarten and First Grade, will act as a facilitator to their discussion, guiding their learning by asking open-ended questions. If the students ask you a question, answer them back by asking a question of your own. Have a list of open-ended questions prepared ahead of time based on force and motion so that you can help your students start their conversation (with this age of students, this is very important as sometimes they do not know how to begin a conversation connected to a topic. See appendix for examples).

In order to have these deep conversations, it is necessary to have some procedures in place so that everyone gets a chance to share their information. The first procedure I have is to have all my students come to the carpet and sit in our 'sharing circle'. The sharing circle is when they come to the carpet and sit on a letter (the letters run around the outside edge of the carpet) where they are facing the middle. There are three sides that the students are allowed to sit on because the last side is where I sit so that I can guide the conversation.

Conversation is the most important part of the Socratic Seminar, so there must be steps put into place to ensure that there is a conversation, not just people shouting out. In my class we will utilize the 'Share Bear'. When a student has the 'Share Bear', they are the only one who may share their thoughts, feelings and ideas. In order to get a turn with 'Share Bear', the students must listen to each other and raise their hand only when the

first child has finished speaking. That child will then pass the 'Share Bear' on to the next student. Once the students get the hang of waiting for their turn to talk, the 'Share Bear' can be either kept or phased out. Also remind your students to respect each other; there are no bad ideas or thoughts.

Science Journals

Journals give students a chance to process their thoughts about what they have read or what they have discussed. After a Socratic Seminar where a lot of material is covered, it gives the student a chance to process that information and pick the piece that sticks out to them and that they may want to focus on or remember. "Through writing – and drawing as well – students can express and expand their thinking and improve their ability to reflect".[5] The teacher then can assess how well the student understood the topic and guide their lesson for the following day to help them understand the topic.

The students will write down their hypotheses every day in their journal based on questions that I pose to them at the beginning of each lesson. As kindergarten students, I want them to begin predicting what they are going to do in Science, not just when they are reading. After they record their hypothesis, they will conduct the experiment and record the results on the next page in their journal. My students will then be able to see if their hypothesis was correct. On a third page, they will record something that they learned or found interesting during the course of the experiment (or discussion if applicable).

Technology

Technology abounds in nearly every aspect of life nowadays from personal computers, cell phones to iPads or other tablets. With all of this technology around, it is necessary to incorporate it into the classroom to help students learn. I have a Smartboard in my classroom that I will utilize to help my students gain a better understanding of force and motion. I will create Smart Notebook lessons that give the students a chance to come up to the board and interact by moving objects into categories or as a fill in the blank that the students can check to see if they are right by themselves.

I will be able to utilize my school's subscription to Discovery Education, which allows me to search for videos that help explain force and motion. Force and motion is a hard topic to explain to Kindergarten students since they do not realize how many things work to make things move, but having a video to illustrate it with simple language allows my

students to see how force and motion work. Discovery Education also has interactive labs that the students can interact with.

This school year, my school is fortunate to have 1-1 technology for all students. This means that all of my Kindergarten students have access to their own Chromebook. There is a wonderful website, The University of Colorado Boulder PHET site in which they have a lot of interactive labs for students. Some may be hard for Kindergarten age, but there is one lab where they mix and match people to pull a cart like in tug of war. Instead of projecting it on to the Smartboard and ask for individual students to come up and experiment with different combinations, I can have my students work individually and explore the lab on their own and then bring them together to discuss what they found and even have some students model their findings on the Smartboard.

Science Labs

By having my Kindergarten and First Grade students complete labs, it makes the content more concrete for them. There is a quote by Benjamin Franklin that says, "Tell me and I forget, teach me and I may remember, involve me and I learn."[6] Students need a chance to manipulate concepts themselves in order to get full understanding of what is being asked of them. Force and motion is a wonderful topic in which to get the students up and moving and actually trying out the concepts that I will be teaching.

We will be utilizing some simple labs that will help my students gain an understanding of force and motion. Along with our discussions about force and motion, my students will complete labs that include kicking different sized balls to see how far they travel, kicking with different forces (hard or soft kick) and kicking to reach targets. My students will also be interacting with carts and will be talking about what makes it easier or harder to push or pull them.

Classroom Activities

These lessons are designed to give Kindergarten and First Grade students hands on experiences with force and motion. Since they are hands on activities/labs, there are a lot of materials that will be needed in order to implement the lessons as described. A complete list of materials and when to use them is included in the Resource section. My unit consists of five lessons/labs that run for 45 minutes apiece.

Lesson 1 – Introduction

I will begin my lesson by bringing out a bag of various balls (small, medium, and large) and take my students outside. I am not going to say anything to my students ahead of time, since I want them to make their own observations while we are outside. Once outside, I will take my students to the softball field since it is fenced in and will be great at keeping the balls confined to one area. I will then pass the balls out to my students and just let them have fun kicking the balls. I will give them at least 15 minutes outside and just observe what they are doing. I will be walking around to listen to hear what my students are talking about. Hopefully, I will be able to overhear some of my students talking about how far or not so far their balls traveled. When the time limit is up, I will collect the balls, line up my students, and head back to the classroom to discuss what we just did.

Once back in the classroom, I will have my students sit in a circle and I will sit on the floor with them and ask them about what they noticed or what they did. While they are talking, I will be writing down some of the things that they are saying in order to remember what the students have discussed for future lessons. I will also gently turn the conversation (if they haven't already) to how far the balls went after being kicked, if they noticed a difference in the size of the balls as compared to how far they went and so on. I want my students to make the connection that the balls traveled farther the harder they kicked it. I also want them to realize that the smaller balls (less mass) will travel farther than the bigger balls (more mass) with a harder kick.

After our discussion, I will introduce the topic of force and motion. I will define force and motion for my students, as the majority of my students are ESL students who need visual support to help them understand the concept. After defining it, we will act it out by pretending to push something in order to show force and dancing to show motion. Then I will have a few students repeat what we have done to ensure that my students understand what we have talked about. I will then let them know that they will become scientists for the week and will experiment with force and motion throughout the week.

Lesson 2 – Pushes and Pulls

On our second day of force and motion, we will take a quick review of what we had seen, done and discussed the day before. I will then read the book, "Push and Pull" by Patricia J. Murphy to my students as an introduction to what we will be talking about today. The book does a good job of describing what pushes and pulls are and how they make things move. We will then watch a quick video segment on pushes and pulls so that my

students will be able to get a visual of what we have been talking about. We will then talk about what we have seen and I will ask some questions to help my students gain comprehension of our topic.

I will then divide my class into 4 groups and pass out four jump ropes. I will then have my students experiment within their groups on how pushes and pulls work by playing tug of war. I want my students to see what happens when you have an equal amount of people pulling on either side, and what happens when there is an unequal amount of people. I will then give my students approximately 15 minutes to explore while I walk around the room listening to their conversations. I want to hear them talk about what they have learned and put into action. I will also guide my students towards starting a discussion if they seem to be struggling with how to begin. Having ESL students means that there needs to be a lot of modeling done for them.

After giving my students time to figure out pushes and pulls by playing tug of war, I will ask them to figure out how to evenly divide the class in half so that we would have two fair teams playing tug of war. I want my students to be able describe why certain students should go where (he should be at the back of the line because he is the tallest, etc…). Then once we have been divided, we will play tug of war a few times to see what happens. After the first try, we can make some adjustments and try again. Then I will have my students get out their science journals and I will have them record what they have learned from the lesson. They can either record their findings by drawing pictures, sounding out words, or having a combination of both drawings and words.

Lesson 3 – Scooters

As always, we will begin our lesson with a quick review of what we had covered the previous day. Then, I will get out four scooters that I borrowed from our gym teachers and introduce our topic of mass today. I will read the book, "What is Mass?" by Don L. Curry to my students. I will then facilitate a conversation about what mass is and what mass does to things. I will once again show my students the scooters that I borrowed from the gym. I will also show them some different things (a full backpack, a box of books, a gallon of water, etc…) that we will put on top of the scooters to change the mass and see what happens. I will then have my students record their predictions of what will happen when we put the different objects on the scooters in their science journals.

We will once again break into our small groups, with each group getting a scooter and a bunch of materials. The only instruction that I will give my students is that they need to, at some time, put the objects on the scooters and see what happens when you try to move the scooters. I will keep reminding my students that we are talking about mass and how it affects how things move. I will then let my students work with their groups to find the answer to our question, "How does mass affect how things move?" Make sure that you continue to circulate the room, listening in to the student's conversations and making sure that what they are talking about is on topic. Help guide the conversation if the students seem to be struggling, but let them decide how they will go about answering the question.

When time is up for their exploring, bring them back together on the carpet with their science journals. Have them take a few minutes and record what they saw while doing their experiment. Make sure that they are still sitting with their groups so that they can share their ideas together. After they have recorded their observations, we will start a discussion of what they encountered. I want my students to be the ones in charge of the discussion, as they were the ones who ran their own experiments. As the teacher, just help guide the discussion and let the students model what they are trying to explain so that everyone can understand what they are trying to share. When the students have sufficiently shared what they have learned, go back to their predictions and see if any of them had predicted correctly.

Lesson 4 – Observation Day

As with our other lessons, we will begin with a review of what we had already covered during the week. This will be a good time to review vocabulary words like force, motion, mass, push and pull. After we are done reviewing the previous terms, I will introduce friction to them by reading the book, "What is Friction" by Lisa Trumbauer. After reading the story, I will model friction with a toy car on the floor. I will model giving the toy car a force (a push) and see where it stops (because of friction). We can then push the car across the carpet to see if it will travel as far as it did on the tile floor. I want my students to understand that friction happens and that there are different types of friction that can affect how things move (smooth surfaces vs. bumpy surfaces).

I will then take my students outside again to the field with our multi-sized balls again. This time, my students will also bring their science journals because this time, they will not being the ones kicking the balls, but a buddy class will be. The students will be observers and will take what they have learned throughout the week and apply it to what

they see their buddy class doing. Hopefully it will lead to discussions on force, motion, friction, pushes and what it takes to move things. I also want my students to see how if the ball is kicked hard, it will go farther than the ball that is kicked softly.

After we have finished observing our buddy class kicking the different sized balls, we will go back inside the classroom and I will have my students write about an interesting thing that they observed outside. I will give them at least 20 minutes to think about what they have seen, and they can go back to where they may have 'written' notes about what they observed. They will then write at least three sentences (1- What was interesting that you observed? 2- Why was it interesting? and 3- Why did it happen?). They can then illustrate a picture to match their words. Afterwards, you can have some students share their stories if they want.

Lesson 5 – Assessment – How close can they get to different targets?

Today is the day where my students will show what they have learned throughout the week. I have an informal assessment set up for my students outside where they will kick the balls again, but this time, they will see who can come the closest to the three targets that I have set up at varying distances. I will remind my students of what they have observed throughout the week and especially some of the things that they had observed the previous day. I will tell them that the only goal of this assessment is to see how close we can get to the targets. How they get the balls to the targets will be left to the students as long as they stay behind the line to kick. They will have to think about how hard or soft they may have to kick the ball in order to get it to the targets.

Once outside with the balls, I will show the targets to my students as well as the line that we will be kicking from. Since I will have one ball for each of my students, I will go through and label each ball with each student's name so that we can keep track of who kicked the ball the closest to the target. We will then take three attempts at reaching the target, stopping to compare each try. We will write down the names that we feel are the closest to the target and the students can ask each other what they are doing to get close to the target. We will then repeat the steps at each of the remaining targets.

Once we have made all our attempts at reaching the targets, we will pack up our supplies and head back to the classroom. Inside the classroom, we will look at who was the most successful at reaching the targets. We will also talk about what the students did

to get the ball as close to the target as possible. After spending a few minutes discussing what they did and how they did it, I will have my students once again return to their science journals. They will need to write about what they learned and how it helped them to get to the targets. Remember that some may be writing words, some may be sounding out words and some may still just be drawing pictures. Either way, give them some time to write down what they experienced throughout the week and how they liked the experiences that they have had. At the end, if there is time, have some volunteers share how they enjoyed/not enjoyed these lessons and have them explain their reasoning.

Appendix 1
Implementing Common Core Standards:

These are the standards that my unit will address and will be met in multiple ways. The science standard will be met throughout the unit as the students complete their labs. The reading standards will be met through reading science books about force and motion. The writing standards will be met through their work in their science journals. The rest of the standards are speaking and listening standards. These standards will be addressed throughout the unit as the majority of our time will be spent on discussing our labs and findings.

K.P.1.1: Compare the relative position of various objects observed in the classroom and outside using position words such as: in front of, behind, between, on top of, under, above, below and beside.

K.P.1.2: Give examples of different ways objects and organisms move (to include falling to the ground when dropped):

- Straight
- Zigzag
- Round and round

RI.K.1: With prompting and support, ask and answer questions about key details in a text.

RI.K.2: With prompting and support, identify the main topic and retell key details in a text.

RI.K.3: With prompting and support, describe the connection between two individuals, events, ideas, or pieces of information in a text.

RI.K.4: With prompting and support, ask and answer questions about unknown words in a text.

RI.K.5: Identify the front cover, back cover, and title page of a book.

RI.K.6: Name the author and illustrator of a text and define the role of each in presenting the main ideas or information in a text.

RI.K.7: With prompting and support, describe the relationship between illustrations and the text in which they appear (e.g., what person, place, thing, or idea in the text an illustration depicts).

RI.K.8: With prompting and support, identify the reasons an author gives to support points in a text.

RI.K.9: With prompting and support, identify basic similarities in and differences between two texts on the same topic (e.g., in illustrations, descriptions, or procedures).

RI.K.10: Actively engage in group reading activities with purpose and understanding.

SL.K.1: Participate in collaborative conversations with diverse partners about Kindergarten topics and texts with peers and adults in small and larger groups.

A: Follow agreed-upon rules for discussions (e.g., listening to others and taking turns speaking about the topics and texts under discussion.

B: Continue a conversation through multiple exchanges.

SL.K.2: Confirm understanding of a text read aloud or information presented orally or through other media by asking and answering questions about key details and requesting clarification if something is not understood.

SL.K.3: Ask and answer questions in order to seek help, get information, or clarify something that is not understood.

SL.K.4: Describe familiar people, places, things, and events and, with prompting and support, provide additional detail.

SL.K.5: Add drawings or other visual displays to descriptions as desired to provide additional detail.

SL.K.6: Speak audibly and express thoughts, feelings, and ideas clearly.

L.K.6: Use words and phrases acquired through conversations, reading and being read to, and responding to texts.

W.K.2: Use a combination of drawing, dictating, and writing to compose informative/explanatory texts in which they name what they are writing about and supply some information about the topic.

Reading List for Students

Barkan, Joanne. 2004. *What is Velocity?* New York: Children's Press.

Curry, Don L. 2004. *What is Mass?* New York: Children's Press.

Murphy, Patricia J. 2002. *Push and Pull.* New York: Children's Press.

Trumbauer, Lisa. 2004. *What is Friction?* New York: Children's Press.

All of these books are excellent for making concepts easier for younger students to understand.

Examples of Open Ended Questions that can be used:

What would happen if _____?
Why did the author write that?
What could we do differently?
What was your favorite experiment? Why?
If you could change one thing in your experiment, what would you change?
Can you tell me what happened?
Do you have any other ideas?
What did you see?
What did you notice?
What did you learn?

Materials for Classroom Use

1. Science journals
2. Discovery education videos
3. Books
4. Chart paper for ideas
5. Markers
6. Different sized outdoor balls, at least one for each student
7. Scooters
8. Weights for scooters
9. Targets to set up outside
10. Computer with a projector
11. Chromebooks

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[1] "Media Room."*Charlotte Mecklenburg Schools*.N.p.,n.d. Web. 1 Nov. 2013. <http://www.cms.k12.nc.us/mediaroom/aboutus/Pages/Didyouknow.aspxyword... >.

[2] 2015. *National Aeronautics and Space Administration.* May 5. Accessed September 13, 2016. https://www.grc.nasa.gov/www/k-12/airplane/newton.html.

[3] 2015. *National Aeronautics and Space Administration.* May 5. Accessed September 13, 2016. https://www.grc.nasa.gov/www/k-12/airplane/newton.html.

[4] n.d. Northwest Association for Biomedical Research. Accessed October 15, 2015. https://www.nwbar.org/teacher-center/education-strategies

[5] Pinnell, Gay Su, and Irene C.Fountas."Writing about Reading."In The Continuum of Literacy Learning Grades PreK - 8. 2008. (Reprint, Portsmouth: Heinemann, 2011). 74.

[6] “”Tell me and I forget, teach me and I may remember, involve me and I learn.” Goodreads.N.p.,n.d. Web. 18 Nov. 2013.

Resources: A Bibliography for Teachers

"Media Room."*Charlotte Mecklenburg Schools*.N.p.,n.d. Web. 1 Nov. 2013. <http://www.cms.k12.nc.us/mediaroom/aboutus/Pages/Didyouknow.aspxyword... >.

This is the website for Charlotte Mecklenburg Schools. It gives great information about our district and the schools that are located within.

2015. *National Aeronautics and Space Administration.* May 5. Accessed September 13, 2016. https://www.grc.nasa.gov/www/k-12/airplane/newton.html.

This is a wonderful website that puts terms on a very easy to understand level. They have varying levels of text that can guide any student K-12.

n.d. Northwest Association for Biomedical Research. Accessed October 15, 2015. <https://www.nwbar.org/teacher-center/education-strategies>

Pinnell, Gay Su, and Irene C.Fountas."Writing about Reading."In The Continuum of Literacy Learning Grades PreK - 8. 2008. Reprint, Portsmouth: Heinemann, 2011. 74.

“”Tell me and I forget, teach me and I may remember, involve me and I learn.”." Goodreads.N.p.,n.d. Web. 18 Nov. 2013. may>.

This website is a good website to look up quotes that you may have heard.