Tales of Science

By Joan S. Wagner

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The Case of the Ball that Would Not Bounce

One day, Tiah and Amelia found a strange ball. When they dropped it, they found that it would not bounce like other balls they had encountered. Tiah was ready to place it in the recycle bin but Amelia stopped her.

"Wait! Don't throw it away yet. Let's see if we can figure out why the ball won't bounce first."

"We're not doing an experiment, are we?" Asked Tiah, with a little attitude.

Amelia grinned and nodded.

"But that is what we do in school, Amelia. You have to be kidding," said Tiah desperately.

"No Tiah, trust me, this will be fun," replied Amelia to her best friend.

"Whatever," responded Tiah with her favorite answer.

The two girls walked into Amelia's room and sat on her bed. As they examined the ball, they noticed that it felt and looked like any ordinary rubber ball, so why didn't it bounce?

"OK, Amelia, there is nothing we can tell by how the ball feels so let's dump it and Facetime Tonya," said Tiah starting to get bored.

"Don't you think it is weird that the ball feels exactly like any ordinary rubber ball but does not bounce? Come on Tiah, it is rainy outside anyway, it can be fun to find out why it doesn't bounce," replied Amelia, slightly annoyed her friend does not share her interest.

"Whatever," replied Tiah.

"Let's see what other balls we can find," suggested Amelia.

"Why?" Asked Tiah.

"You'll see," replied Amelia.

So, they went around Amelia's house and found several different balls.

Hey, Amelia, look what I found under your sister's bed, it's one of those high "bouncing balls," said Tiah, as she bounced the ball and watched it almost hit the

light in the ceiling.

"Whew, close call. My parents wouldn't have been happy if we broke the light," said Amelia, as she watched the ball almost become a problem.

The girls took inventory of the balls they collected: a large soft rubber ball, medium size rubber ball, high bouncer, tennis ball, ping pong ball, golf ball and a plastic ball

"Wow, you sure have lots of balls in your home," noted Tiah. "Don't tell me you want to drop all of the balls," she continued with a touch of sarcasm in her voice.

"Yup," replied Amelia, "And I will give you the honors of starting the experiment."

"Whatever," replied Tiah and she reluctantly dropped the ball first.

"Notice how the ball bounces lower and lower after each bounce," said Amelia, excitedly.

"What's so strange about that, all balls do that," replied Tiah.

"But why does it bounce lower and lower until it cannot bounce anymore? Asked Amelia.

"Perhaps, it just gets tired," replied Tiah.

"Very funny," said Amelia, rolling her eyes. Now think, Tiah, if we can answer that, we can find out why the ball we found can't bounce," Amelia continued with a determined look on her face.

"Hmm, OK, now you are making me a little curious," said Tiah. "Let's take turns dropping the remaining balls. Since I went first, it is your turn, Amelia,"

See, this is fun," said Amelia feeling very determined to discover why the ball

they found would not bounce.

"Whatever," repeated Tiah, though a little more softly.

After all of the balls were dropped, Tiah then said, "well, no surprise, all the balls bounced lower and lower until they no longer could. Just like the first ball, they too got "tired" and stopped bouncing, though none of them bounced as long as the high bouncer. Boy, that ball must have been really tired when it stopped bouncing,"

"Balls can't feel anything," said Amelia, they just have less energy to bounce.

"When I feel tired, I have less energy so it just made me think the balls have less energy too," said Tiah.

"Well you might be on to something there, but we can get back to the energy stuff later" replied Amelia. "For now, let's concentrate on what we can observe about a bouncing ball. What else do you notice when a ball bounces?"

"Beats me," replied Tiah, trying to hold on to three balls.

Just then the ping pong ball fell out of her hands.

"Hey, did you hear that? Said Tiah. "I have an idea, let's listen to the sounds each ball makes when it bounces" she continued, surprised she was actually getting into experimenting.

"Whatever," replied Amelia. "Oh, just kidding, you have a great idea. Let's take turns again dropping each of the balls and listening to the sound each one makes."

The girls decided to create a chart (as they were taught in school) that listed all of the balls, the number of bounces, how long they bounced, in addition to the sound each ball made.

"The balls sure do make different sounds, stated Tiah after listening to all of the balls.

"Yeah," replied Amelia, "Some are high pitched while others are low pitched. The large rubber ball makes a loud, hard sound while the tennis ball makes a softer sound," She continued.

"You know it could be fun to play a game in which you had to guess the type of ball by listening to it bounce," suggested Tiah

"Tiah, interesting, but let's stick with our task, please," Amelia pleaded.

"Okay, Okay and when they invent a famous APP game on bouncing balls, you will be the reason we didn't get famous," replied Tiah, wishing her friend would chill out a bit.

Amelia, determined to keep her friend on task, asked her which balls had the lowest pitched sound.

"You will see I did pay attention, Amelia, "the squishier balls made a lower pitched noise than the others. Honestly, I am interested in solving the mystery of the ball we found that forgot how to bounce. Maybe it's sick and needs to see a ball doctor. Oops, just kidding Amelia. It's just you get so serious about it. I am trying to lighten things up a bit," Tiah continued trying to explain her behavior to her friend.

"No problem, Tiah, "you are still my best friend. Now let's look over our chart and the data we have collected so far for each of the balls," Amelia suggested.

"I agree, it is a good idea to see what info we have so far, replied Tiah.

"You know, Mrs. Tuchman, our science teacher would be very proud of the chart we created," said Amelia, impressed with the data they had collected thus far.

The chart showed some of the balls bounced longer than other and the sound was noted as high, low or medium pitched.

Ball Type	**Number of bounces**	**Time**	**Sound pitch**
High bouncer	10	4.48	low
Large Rubber	3	1.93	Medium
Tennis	6	2.83	medium
ping pong	15	8.10	high
golf	8	3.46	high
Medium rubber	8	3.38	Medium
Plastic	9	4.03	high

"While holding a ping pong ball and rubber ball in her hand, Tiah said, "Let's see if the squishiness of a ball affects its bounce. The rubber ball certainly is squishier than the ping pong ball"

"Brilliant," responded Amelia, pleased her best friend was getting into experimenting.

Tiah sat on the floor with their chart in her hand and added the trait of "squishiness" to it. She was going to observe and record each type of ball when it touched the floor after Amelia dropped them. Tiah noticed that the squishier a ball was, the more it changed shape when it hit the ground and when it bounced, it would change back into its original shape.

"I am beginning to feel like a scientist, "Tiah said as she recorded how the balls changed shape when they dropped. "But this is a hard observation. I don't really notice any change with the ping pong ball, plastic ball and the golf ball," she continued.

"Well just write down what you can see and 'no change' when nothing is noticed," suggested Amelia."

"Check, will do," replied Tiah, trying to sound like a scientist.

After recording all the data about the balls, Tiah stood up so they both can look over their findings on the chart.

Ball Type	**Number of bounces**	**Time**	**Sound pitch**	**Squishiness (Shape change)**
High bouncer	10	4.48	low	Small
Large Rubber	3	1.93	Medium	Small
Tennis	6	2.83	medium	No change
ping pong	15	8.10	high	No change
Golf	8	3.46	high	No change
Medium Rubber	8	3.38	Medium	Small
Plastic	9	4.03	high	No change

"Well, each ball certainly has different properties," Tiah noted.

"They sure do," replied Amelia with a confused look on her face.

Sensing this, Tiah said, "What's wrong?"

"Well we have collected a lot of information about different balls, but I still don't get why a ball loses its bounce over time and why the ball we found cannot bounce at all," replied Amelia, feeling very frustrated.

This made Tiah think about her trampoline at home. “You know when I jump on my trampoline, I can bounce for a while on it without jumping. But, eventually I stop bouncing unless I jump again.”

“Are you sure it is not due to your getting tired like the tired ball,” replied Amelia grinning.

“I guess I deserved that reply, after all the kidding you had to take from me,” said Tiah.

Amelia thought this over and yelled, “I got it, I got it. Jumping on the trampoline is sort of like bouncing a ball. If I want the ball to bounce again after it stops, I have to drop it down again. If I want to continue bouncing on a trampoline, I have to jump up again and then each time I hit the trampoline, it pushes me up.”

“Sooooo,” said Tiah puzzled.

“Well if the trampoline pushes me back up then the floor must push the ball back up,” said Amelia, getting very excited.

“Really,” replied Tiah. “A floor can push?”

“Tiah, place your hand on the floor and push down,” directed Amelia. What do you feel?”

Tiah pushed against the floor. “I feel the floor.”

“Keep pushing harder and harder,” said Amelia.

“Ouch, it is beginning to hurt,” said Tiah and she took her hand off the floor.

“Don’t you see,” said Amelia, “the floor is pushing back at you and the harder you push, the harder it pushed back.”

“Definitely weird, but I think I get it,” Now I know why a ball bounces higher when it is thrown at the floor instead of being just dropped. The harder the ball hits the floor, the harder the floor pushes back,” said Tiah, smiling since she was really getting into solving the mystery of the ball that doesn’t bounce. Then Tiah said, “Maybe the reason the ball didn’t bounce was because we didn’t throw it at the floor.”

Tiah threw the ball that would not bounce on the floor but just as before it did not bounce.

“Do it again,” said Amelia wanting to make sure they observe the same thing.

Tiah threw the ball that would not bounce three more times on the ground and it still not bounce.

"Well that kills that prediction," Tiah said with disappointment in her voice.

"Scientists would call it a hypothesis," said Amelia trying to educate her friend.

"Oh yeah, I remember that from school," said Tiah.

"Don't feel bad Tiah, lots of hypotheses turn out not to be true. We just need to gather more data about bouncing balls," said Amelia, trying to comfort her friend.

"I know what we can do next," said Tiah brightening up, "we could find out how long a ball bounces when it is dropped from different heights. It might help us find an answer to the problem," continued Tiah.

"Great suggestion! We can drop the balls from different heights using the stairs, but we better watch out for the lamp below," said Amelia.

"No problem," replied Tiah.

"Should we count the number of bounces before the ball stops or how long it takes the ball to stop bouncing?" Asked Tiah.

"Both," answered Amelia. "You count the number of bounces and I will keep track of the time with a stop watch."

Tiah made a new chart showing the height the ball was dropped, the number of bounces and the time it bounced. They repeated this three times for each ball and recorded the average.

Ball Type	**Height 1 7.9'**	**Time 1 (Sec)**	**Height 2 5.10'**	**Time 2 (Sec)**	**Height 3 4.3'**	**Time 3 (Sec)**	**Average Time (Sec)**
High bouncer	12	6.30	10	5.51	9	5.00	5.57
Large Rubber	4	2.56	3	2.00	2	1.87	2.14
Tennis	7	3.78	6	3.63	5	3.12	3.51
ping pong	18	9.20	15	8.23	14	7.69	8.37
Golf	24	12.75	22	11.41	20	9.65	11.27
Medium Rubber	10	5.35	9	4.45	8	4.16	4.65
Plastic	14	6.05	12	5.96	10	5.21	5.74

Using the stairs, as they expected, the higher the ball was dropped, the longer it bounced and the more it bounced.

The girls looked over their data that they placed on their chart so they can see how the balls compared.

Tiah spoke first. "You know it is sort of weird to watch a ball bounce. Obviously, gravity is what pulls the ball down, but when it bounces up, it's as if it is defying gravity."

"Yeah, if you think of it that way, it is weird except we already determined that the floor pushes the ball up and the strength of the push is determined by how hard the ball hits the floor. Remember what we did earlier!" Amelia said.

"I do, I do, but it is still weird. Normally, no one ever thinks about that but because you decided to solve the mystery of the ball that will not bounce, my brain is on overdrive," said Tiah, looking a bit frazzled.

"Now to summarize what we have observed. Gravity is the force that pulls the ball down and the floor provides the upward pushing force," concluded Amelia acting like she was a teacher summarizing a science lesson at school.

"And, according to our data, the higher the ball is dropped, the longer it bounces. Then again, I am not exactly surprised by that," noted Tiah.

"But do you know why it bounces longer?" Asked Amelia.

"Because it becomes more energetic the higher up it is dropped," answered Tiah, thinking she was just joking.

"You are right," said Amelia. "I told you we would get back to the energy thing you mentioned earlier."

"I am!" answered Tiah in disbelief. She knew science was not her best subject in school and often depended on Amelia for some help.

Amelia explained. "The higher the ball is dropped, the more energy it can store up. That is why it can bounce longer"

"We did study energy in school. What are those terms we learned in Mrs. Tuchman's class?" Asked Tiah.

Amelia thought a moment. "Mrs. Tuchman said that stored energy is called

potential energy, and if it has to do with gravity, such as our bouncing balls, then it is called gravitational potential energy."

"Really, how do you remember that stuff?" Asked Tiah impressed with her friend's ability to recall information like that.

"I don't know, I just do," answered Amelia.

Then Tiah started to smile. "You know, when you think about all this it's as if the ball is running out of the energy it needs in order to bounce."

"Yup, it gets exhausted as you would say and just stops bouncing because it has run out of the energy needed to move," replied Amelia.

"What do you call that motion energy we learned about in school, no, no wait, I think I remember, it is kinetic energy. My mother goes to a kinetic exercise class and obviously, they do a lot of moving, so that is why I can remember that word" said Tiah.

"Let's review what we learned about bouncing balls," stated Amelia, always a bit of the teacher in her.

"Okay, so when the ball bounces up, it is storing energy, also known as gravitational potential energy, not bad, huh, Amelia," said Tiah proudly because she remembered the term.

"I'll make a scientist out of you yet," replied Amelia.

Amelia continued, "So when the ball bounces as high as it can, that must be the maximum amount of stored energy it can store."

"This is actually making sense to me," said Tiah in disbelief. "And as the ball falls down, its potential energy is changed back into energy of motion or kinetic energy. Oh no, I am becoming a nerd like you Amelia," said Tiah, with a broad grin on her face"

"Welcome to my world," replied Amelia. "So now we both know a bouncing ball stores up energy when it moves up and releases it as kinetic energy when it falls down."

"And since it bounces lower and lower, less and less energy is stored so when it can no longer store up energy to bounce, it stops bouncing. Poor ball, must feel sad not being able to bounce anymore," noted Tiah.

Tiah, why are you always giving feelings to balls? They only thing they 'feel' is the push from the floor when it is bouncing," said Amelia, a little annoyed that her friend continues to give feelings to a nonliving thing.

"Amelia, you really need to lighten up. I like to give emotions to the ball, it makes doing this more fun," replied Tiah, a bit annoyed.

"Sorry Tiah, I do have to lighten up," said Amelia to Tiah, "Speaking of fun, remember the good times we had on the slide when we were in elementary school?

"Yeah, it was fun, sliding down together or going face down. Though I do remember going down the slide too fast and ending up in the mud. What made you think about the slide?" Asked Tiah

Amelia replied, "Well, when we climbed the slide, we were storing up energy just like a ball does when it bounces."

"And as we slide down the stored energy gets changed into energy of motion," Added Tiah.

"And when we reach the bottom of the slide, we run out of stored energy so we had to climb the slide ladder again to store up enough energy to get the ride down," said Amelia.

The girls looked at one another smiling because they really felt they were getting close to solving the mystery of the ball that would not bounce.

"So, the ball must bounce lower because it is losing some of its ability to store up energy, but why?" Asked Tiah, now feeling very puzzled.

"So, now our mystery is to figure out why the ball loses its ability to store up energy," said Amelia feeling a bit puzzled too.

"Wait a minute, I think I know what happened to the energy," replied Tiah excitedly.

"You do, what?" Asked Amelia.

"Remember when we studied energy in science class, Mrs. Tuchman said heat and sound are forms of energy," stated Tiah enthusiastically.

"So," said Amelia

"Well the ball does make a sound when it hits the ground," replied Tiah, "Remember, we did test for that characteristic."

"Brilliant, said Amelia, so some of the energy needed for a bouncing ball changes into sound."

"And sound is not exactly useful when a ball just wants to bounce," added Tiah.

"There you go giving feelings to bouncing balls again," replied Amelia.

"Whatever," replied Tiah.

"Sorry Tiah.

"How do you get heat from a bouncing ball?" Asked Tiah

"Let me think about it a minute. Okay, I think I got it. When a ball touches the ground, some rubbing must take place. And when things rub together, there is friction," said Amelia as she was interrupted by Tiah.

"And where there is friction, heat is released," jumped in Tiah. "Sorry Amelia, but when you started talking about rubbing and friction, I found myself rubbing my hands together and immediately noticed they got warmer. Of course, I already knew that happens when you rub your hands together but I never connected it to a bouncing ball.

"Wow, Tiah, you are really impressing me. See, I said this was going to be fun," said Amelia.

"It has been fun doing this on this rainy day, but we still have not solved the mystery of the ball that does not bounce," noted Tiah.

"But we have solved the mystery of why a ball bounces lower and lower and then stops," said Amelia.

"And that is why? Just kidding," said Tiah. The balls bounced lower and lower and then stopped bouncing because some of the energy needed to bounce was changed into heat and sound after each bounce. Obviously, those are types of energy not very useful to balls that just want to bounce and have fun," continued Tiah.

"Okay, now you got me feeling sorry for those poor balls that can't bounce anymore," joked Amelia.

"And if you think about the slide ride, the rubbing causes friction so heat is released and there is sound as you slide down and when you hit the ground," observed Tiah.

"You are super impressing me, Tiah. Just imagine how the slide ride would go if there was no sound or heat released," remarked Amelia.

"We probably would have broken all of our bones because of going too fast so heat and sound actually saved us a lot of pain," replied Tiah.

"You really need to get more daring," said Amelia, who was known to be a dare devil on the playground.

"Whatever!" Said Tiah.

"Okay, but we still need to figure out why this stupid ball won't bounce," said Amelia, feeling somewhat frustrated.

Amelia was holding a couple of balls in her hands. Tiah picked up some balls too.

"Some of the balls are definitely squishier than others," noted Amelia.

"Well we already know that from our earlier experiment. Remember, I was able to see the squishier a ball is, the more it changes shape when it strikes the ground," Tiah reminded her friend.

"Yes, I remember, but we need to study this some more. Just think, what if a ball cannot change back to its original shape easily? Will this affect the ball's ability to bounce?" Asked Amelia.

"So, we need to do some more testing, but what should we test?" Asked Tiah feeling unsure as to what to do next.

"I got it," Amelia said. "Suppose our hypothesis is that the squishier a ball is, the less it is able to bounce because it does not change back to its original shape. Then when it hits the ground, it exerts less of a force and so the ground also pushes with a lesser force"

"Wow, Amelia, you sure know how to hypnotize," said Tiah

"You mean hypothesize, Tiah not hypnotize," corrected Amelia.

"Whatever," replied Tiah. "So, what do we do next?

Amelia thought about this. "Well, if I push a balloon against the floor and then let go, it bounces up and goes back to its original shape. But, it doesn't bounce very high." Amelia got up and walked to the kitchen counter. She opened the draw where her mother kept birthday balloons. She brought back three balloons. She inflated one balloon so it was very taut, one medium taut and one was very squishy.

Amelia asked Tiah to bounce each of the balloons while she made observations.

"We already have information about squishy balls," said Tiah.

"I know, but using the balloons will make it easier to observe how the amount of squishiness affects a ball's bounce."

"Whatever," said Tiah.

Tiah first released the balloon with the most air. Amelia noted how many times it bounced. She did the same for the other two balloons.

"Well, no surprise that the least squishy ball bounced the longest," said Tiah.

"Agreed, no surprise," replied Amelia, "but do you know why?'

"It depended on how hard it was able to push on the ground to bounce, just like before" said Tiah.

"Tiah, you will be a scientist yet. That is what I think too. And remember the ground pushes back with an equal force so if the balloon does not return to its full shape, it can't push as hard, so the ground doesn't push as hard too," said Amelia, getting very excited with her insights.

"I am actually understanding what you are saying, Amelia, but how does this explain why the ball we found does not bounce. It doesn't even feel squishy. Did it lose its touch and just could not push anymore?" Asked Tiah, also getting excited with the prospect of solving the mystery.

"Exactly," replied Amelia.

"You are kidding," replied Tiah startled she was actually correct.

"The ball we found lacks the ability to push." Noted Amelia.

"So, the ball stupidly changes all of its energy into heat and sound instead of storing up energy that would allow it to bounce like a regular ball," said Tiah not sure what she was saying actually made any sense.

"Exactly," replied Amelia again.

"I am becoming a scientist. Maybe I will become a rocket scientist," stated Tiah with confidence.

"I wouldn't push it," replied Amelia, but pleased her friend was sharing her interest.

Amelia picked up the ball that would not bounce and dropped it to the floor. It made a thud sound and did not bounce.

"Though this ball looks like an ordinary rubber ball, it is more similar to a very squishy ball that cannot push very hard when it hits the ground. Only, it fooled us, because it did not feel squishy," said Amelia.

"It must be made of something that does not go easily back to its original shape when it hits the ground, only it is not noticeable to us" added Tiah.

Both girls were quiet for a while.

"What are you doing?" asked Tiah.

"Thinking," replied Amelia.

"Oh yeah, I can see the smoke coming from your brain," joked Tiah.

"I think the mystery of the ball that will not bounce has been solved."

"Really?" questioned Tiah

Really," answered Amelia.

"I bet it has something to do with the push of the ball," said Tiah.

"Right, I knew there was a reason we are friends. We both love science." Said Amelia.

"I wouldn't push it that far, but then again I am toying with the idea of becoming a rocket scientist well maybe an assistant rocket scientist," said Tiah with a little sarcasm in her voice.

"We did solve the mystery of the ball that will not bounce. And it is not because it is too lazy to bounce. When it hits the ground, it changes shape slowly so its push on the ground is weak. But just like the ping pong ball and golf ball, it was hard to observe. Then the ground pushes back with the same weak force, but not enough to give the ball a bounce. In the case of our ball that would not bounce, none of its energy of motion could be changed into stored energy. Instead, it all turned into heat and sound," concluded Amelia.

"Who would have ever thought there was so much science that goes into the bouncing of a ball," said Tiah, with an exhausted sigh.

"Look, it stopped raining, let's go outside and play soccer in my yard," suggested Amelia.

"Brilliant, our brains can use a rest for now and you know what they say, 'a strong body makes for a strong mind'," replied Tiah, happy to run around outside, but feeling

pleased to have solved the mystery of the ball that would not bounce with her best friend, Amelia.

"Hey Amelia, maybe next time in science class, I can help you."

"Whatever," replied Amelia.

DISCUSSION QUESTIONS: "The Case of the Ball that Would Not Bounce"

1. How could Amelia and Tiah improve their experiment when they dropped the balls?

2. Why do some balls not bounce as high as other balls?

3. Why can't a ball bounce forever?

4. Using Newton's three Laws of Motion, explain the movement of a bouncing ball.

5. The ball that did not bounce was made of a certain type of matter. Can you think of any other uses for this type of matter?

6. What types of energy changes did Tiah and Amelia observe watching a ball bounce?

The Case of the Ball That Would Not Bounce Science Terms

1. ***Gravity:*** A property of matter that has an attraction for other matter. The more matter, the greater the attraction.
2. ***Force:*** A push or pull
3. ***Friction:*** A force that opposes motion.
4. ***Gravitational Potential Energy*:** Stored energy dependent on the weight of matter (from pull of gravity) and the height from which it falls. Mathematically expressed as: GPE = $9.8ms^2$ x mass x height.
5. ***Heat Energy***: Energy that moves from an area of higher temperature to one of lower.
6. ***Hypothesis***: A prediction based on observations.
7. ***Kinetic Energy***: Energy of motion. Mathematically expressed as $1/2M \times V^2$
8. ***Motion:*** Any movement or change in position relative to an observer.
9. ***Newton's Third Law: Action Reaction:*** For every action, there is an equal but opposite reaction
10. ***Potential Energy***: Stored energy
11. ***Sound Energy:*** Energy produced by the vibrations of matter.
12. ***Temperature:*** A measurement of the average kinetic energy in matter.

NGSS

MS-PS1 Matter and Its Interactions

Disciplinary Core ideas

Definitions of Energy

•The term "heat" as used in everyday language refers both to thermal motion (the motion of atoms or molecules within a substance) and radiation (particularly infrared and light). In science, heat is used only for this second meaning; it refers to energy transferred when two objects or systems are at different temperatures.

Developing Possible Solutions

•A solution needs to be tested, and then modified on the basis of the test results, in order to improve it.

MS-PS2 Motion and Stability: Forces and Interactions

Disciplinary Core Ideas

Forces and Motion

1. For any pair of interacting objects, the force exerted by the first object on the second object is equal in strength to the force that the second object exerts on the first, but in the opposite direction (Newton's third law).
2. The motion of an object is determined by the sum of the forces acting on it; if the total force on the object is not zero, its motion will change. The greater the mass of the object, the greater the force needed to achieve the same change in motion. For any given object, a larger force causes a larger change in motion.

Types of Interactions

1. Gravitational forces are always attractive. There is a gravitational force between any two masses, but it s very small except when one or both of the objects have large mass—e.g., Earth and the sun.

MS-PS3 Energy

Disciplinary Core Ideas

Definitions of Energy

1. Motion energy is properly called kinetic energy; it is proportional to the mass of the moving object and grows with the square of its speed.
2. A system of objects may also contain stored (potential) energy, depending on their relative positions.

Relationship Between Energy and Forces

1. When two objects interact, each one exerts a force on the other that can cause energy to be transferred to or from the object.

Conservation of Energy and Energy Transfer

1. When the motion energy of an object changes, there is inevitably some other change in energy at the same time.

Science and Engineering Practices

- Constructing explanations and designing solutions
- Obtaining, evaluating and communicating information
- Planning and carrying our investigations
- Engaging in argument from evidence

Crosscutting Concepts

- Patterns
- Cause and effect
- Scale, proportion and quantity
- Energy and matter

Joan Wagner has a love affair with science education. She taught science for 34 years, grades 7-12, mostly in grades 7&8. She is the co-author of the *Big 8 Science Review and Test Prep*, published by N&N Publishing and had written 3 workbooks for DK Publishing called "Learn Science," which adapted UK books for the US. She is a past president of the Science Teachers Association of New York State (STANYS) and is presently a member of its conference committee. She chairs the Education Committee for the Dudley Observatory and is the Director of the Greater Capital Region Science and Engineering Fair, an affiliate of the Regeneron International Science and Engineering Fair.

Tales of Science is written to teach science though story-telling and encourage children, ages 12-14 to read science. The book is closely articulated to the *Next Generation of Science Standards*. It includes a number of activities students can do at home or school. *Tales of Science* can be used to support a text book or even in lieu of a textbook.

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View of Adirondack Mountains from Cobble Lockout

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