Let Me Tell You a Story

Using storytelling followed by hands-on activities to teach energy transfer to upper elementary students

By Janet Yamaguchi

Let me tell you a story: I recently returned from Alaska where the air was cold and the streets were slick with snow and ice. While I was there, I took my toddler with me to the grocery store to pick up a few items for lunch and snacks for the road. When we left the store, the shopping cart was full of groceries and my bundled-up daughter. I pushed the heavily laden cart to my car, and as I turned away from the cart to open the car door and put the first bag of groceries into the car, the unwatched shopping cart began to roll away, down the icy, sloped parking lot. Needless to say, I was frantic! I noticed that not only were the cart and my toddler travelling quickly down the lot, but they were about to collide with a parked car! And I thought, “As heavy as that cart is and as fast as it is travelling, it’s going to transfer a large amount of energy to that parked car, which in turn will impart a correspondingly large amount of energy to the shopping cart and my young daughter … .”

In fact, this is not a true story, but I use it to introduce the concept of energy transfer when I’m teaching others (whether young students, high school students, preservice or in-service teachers). It has proven to be a very effective and memorable story, even though it’s untrue. The story continues (with no harm to the imaginary toddler), weaving in associated science concepts, while also compelling the listeners to internalize (understand and remember) these science concepts, such as how a change of incline, speed, and/or the coefficient of friction relates to a change in energy transfer. So, what is it that compels the listener to learn and apply these complex physical science concepts to other aspects of real life? Because of the psychology associated with hearing the phrase “Let me tell you a story.”

Researchers Nicole Speer and Jeffrey M. Zacks (2009) studied and documented the levels of brain activity that occurred while others read excerpts from a story aloud to a group of listeners. The researchers discovered that far from just passively listening to the story, the participants were living the experiences alongside the character in the story. For example, neurons in those areas of the brain that are related to grasping and other movements of the hand, lit up when the character in the story picked up, held, or pushed an object. Neurons related to vision fired as the character looked around. Even more interesting: Both the reader and the listener experienced similar patterns of brain activation during this activity and also when they told and listened to unrehearsed stories.
The researchers suggested that to better comprehend a story, we ground the activities about which we’re hearing within our own real-world experiences. These findings show the incredible influence that storytelling can have. An effective story can not only sweep up the listener and cause them to vicariously live the tale but can also cause the listener to store this narrative as a memory that can easily be retrieved. Storytelling, especially when introduced by the phrase, “Let me tell you a story,” is a powerful method of teaching and subsequent learning. Listeners can visualize and absorb the story, then be ready to apply (which is evidence of learning) the information, concepts, and/or message that you want to impart.

Whatever story you might tell, whether from your own life, your imagination, or a treasured storybook, know how impactful it can be when told aloud. If you then go to the next step and follow-up with a related visualization and/or hands-on activity, you can be assured that the introduced concept will be applied by the learner in a most effective way. Why? Because someone listened when you told them a story.

By using a variety of differentiation strategies, such as listening to stories, visualizing scenarios, and performing tactile activities, fourth-grade students will be able to conceive of and express examples of energy transfer.

Visualization

Continuing the exploration of energy transfer, it is helpful to have learners visualize some scenarios connected to the story of the imminent collision between the shopping cart and the parked car. Visualization (in this case) refers to one’s ability to create pictures in one’s head, based on information that the person has read or heard. According to research performed by Stephanie Harvey and Anne Goudvis (2017) the process of visualization strengthens learners’ comprehension skills through their own creation of mental images, particularly when no physical images are shown during the storytelling. Visualization also creates personal links and a more meaningful experience between the learners and the subject matter they visualize. Harvey and Goudvis’ research states that when selecting a story for a visualizing activity, it should contain both deeply descriptive language and the use of strong verbs to conjure vivid mental images.

To initiate a visualization associated with the story of the runaway shopping cart, give the students (in teams of three or four) some props. Distribute protective eyewear, a ping-pong ball, and a roughly 4 ft. length of pipe insulation (cut in half lengthwise to form a curved ramp) to each team, explaining that the insulation will be used to represent the asphalt surface of a parking lot. The groove along the insulation helps contain the ball representing the shopping cart. Working as teams, have them stretch the length of “parking lot” across the floor, holding it in place. Then have them roll the ball along the central groove of the insulation. Each team member can take a turn giving the ball a push along the ramp to determine the varying amounts of energy they need to use to get the “passenger” to travel halfway along the ramp, and then all of the way to the far end of the ramp. Students will comment on how they need to use less energy to push the ball to the halfway point of the path versus to the far end of the path. Have the teammate at the far end of the ramp hold his/her hand to represent a parked car blocking the end of the ramp. Afterward, have the learners discuss how the activity compares to and differs from the shopping cart story. Learners will often state that the pathway on which the ball is travelling is “flat” on the ground and not sloped as the pathway was described in the story; this observation provides the perfect segue into the next component of this learning experience.

Next, ask, “When you heard the story of the runaway shopping cart, did you imagine that the parking lot was gradually or greatly sloped toward the parked car?” Have them hold their pipe insulation as an incline to display their answers. Ask, “How would a difference in incline affect the amount of energy transferred during the collision?” Allow the students to discuss their thoughts concerning a change in slope. (The steeper the incline, the greater the energy transfer to the parked car.) Ask, “Why would the steeper incline result in a greater energy transfer?” (The steeper the incline, the faster the shopping cart will roll toward its ultimate collision with the parked car.) Have the learners visualize, then determine, how the shopping cart and its passenger would physically respond to the collision. The shopping cart and passenger would respond by bouncing away from the parked car. This “bounce” provides evidence that once the shopping cart hits the parked car, a corresponding amount of energy is transferred from the car to the cart. In fact, some of the energy transferred during the collision would be converted from kinetic (motion) energy into heat energy and sound energy (WHAM!) as the air between the colliding vehicles is heated. Have the students demonstrate the collision by a single, strong clap of their hands (WHAM!) to augment their understanding of how kinetic energy is converted into heat and sound during a collision. If the students question the conversion of energy into heat, have them clap multiple times to feel how their hands start to warm.

Ask the students to visualize the Alaskan parking lot scene in their minds; then have them describe the condition of the parking lot itself. Recall the parking lot was slick/slippy with snow and ice! Ask, “How would the ice affect the collision?” Accept learners’ appropriate answers: that an ice-covered parking lot is smooth and slippery, making objects travel faster across it and thereby increasing the potential energy transfer.

Now imagine if you took the toddler out of the shopping cart and replaced her with a 180-pound St. Bernard, then let
the dog and cart roll down the steep and icy incline toward the parked car. Ask, “Will the dog transfer a greater or lesser amount of energy to the parked car than the toddler would?””

Again, accept learners’ appropriate answers: that the greater the weight/mass, the greater the energy transfer. Next, give each team a golf ball to represent the change in mass/weight from a toddler-sized passenger to a St. Bernard-sized traveler. Allow the teams to freely explore with their set of materials (again, using eye protection). When you reiterate the above question, learners will understand that the greater the mass/weight of the “passenger,” the more energy it can transfer during a collision. Also, note that the parked car has much more mass than the dog and cart combined, so the car will transfer a large amount of energy to the laden shopping cart during the collision, even though the car is stationary.

While exploring energy transfer, guide the learners to notice and elaborate on the relationship between these pairs:

- (a) the object’s mass/weight and the force the object can impart during collision;
- (b) the speed of the object and the incline on which the object is traveling; and
- (c) the amount of friction between the moving object and the surface it is traveling across.

### Hands-On Learning

As research by Carly Kontra (2015) and others have shown, hands-on learning enhances the science comprehension of students in many ways while also providing neurological benefits and significantly improving quiz scores. By using brain imaging techniques, she and others demonstrated that physically experiencing concepts changes how learners process information, noting that hands-on experiences are an integral part of learning.

Again, distribute the protective eyewear, ping-pong ball, golf ball, and a roughly 4 ft. length of pipe insulation (cut in half lengthwise to form a curved ramp) to each team of three or four students, along with measuring tape and a 12-ounce plastic cup. They will conduct a set of “collision-based,” energy transfer-related activities. The learners will predict outcomes, then collect, record, and analyze the data that they gather.

Hold up the pipe insulation as you explain that each team will use the insulation as a flexible ramp, allowing the learners to form a variety of inclines down which they will carefully release a ping pong ball, and later, a golf ball. The teams will need to stand 3.56 meters (12 feet) from a wall; place one end of their “ramp” onto the floor, facing the wall; and measure and record the varying heights at which they will hold the opposite end of their “ramp,” upward, off the floor, forming a series of gradual to steep inclines. Learners will determine three heights of their choice for the upward end of their ramp, forming (1) a gradually sloped incline, (2) a “medium” incline, and (3) a greatly sloped incline down which the balls will travel. Before starting the activity, have the learners predict and record some of the general outcomes they expect to find during this investigation. Students may ask if they need to mimic another team’s selected set of ramp heights. The answer is “No.” Each team will determine their own set of ramp heights and analyze their own set of results. In this way, each team will develop a deeper ownership of their learning experience and its subsequent results.

After each trial, the team will measure and record the distance that each ball rolled from the “floor-end” edge of the ramp. In addition, they will separately measure and record the distance of each ball’s rebound (if any) off the imposing wall to its final resting point. The team member recording this data will also note (in agreement with the rest of the team) whether there was a sound (indicating a transfer of energy) created by the ball striking the wall.

The learners should have the ability to conduct the same series of activities on two different types of floor surfaces, such as on a wooden floor, a concrete surface, a carpeted floor, a dirt-covered area, or short-cut grassy area. We have shared data collection sheets online (see Supplemental Resources).

Following the above investigation, the teams will analyze the information to determine similarities and differences in the how the ping-pong ball performed in relation to the golf ball. The learners must explain why the balls “behaved” differently within the various scenarios, while noting the various (a) slopes of the ramp, (b) surfaces the balls travelled across, and (c) properties of the ping-pong and golf ball. Discuss how results of their investigations aligned with or differed from their initial predictions.

The teams will then conduct a similar set of investigations but add a 12-ounce, upside-down, plastic cup placed .3 meter (12 inches) from the floor-end of the ramp, in the ball’s pathway. In this set of collision-based investigations, the teams will focus on the total distance that the cup was moved (indicating an energy transfer) from its original site. Again, have the learners predict and record some of the general outcomes they expect to find. After analyzing the data, the learners must explain why the cup “behaved” differently within the various scenarios, while noting the various (a) slopes of the ramp, (b) surfaces the balls travelled across, and (c) properties of the ping-pong and golf ball. Discuss: Did their findings align with or differ from their predictions?
Check for Understanding

While your students may not have experienced icy/snowy surfaces, steep inclines, or using a shopping cart, they have probably experienced a variety of environments and actions, such as riding a skateboard, hitting a ball, or rolling an object across various surfaces. Have the learners visualize an action-based scenario and then write their own short story, featuring a type of collision or other example of a physical activity resulting in a transfer of energy. The true or imagined story, spotlighting an action used during a sport or other everyday activity, should showcase not only the energy transfer but also the detailed results associated with that energy transfer if the mass/weight, speed, or surface friction of one or more of the objects/people in the story changed. Their opening should be “Let me tell you a story.” Collect and use these descriptive stories as a check-for-understanding by the learners of the concepts associated with energy transfer.

Janet Yamaguchi (janet.k.yamaguchi@gmail.com) has 36 years of teaching experience: four years as a high school science teacher; eight years with the Orange County Department of Education (CA); and 24 years with Discovery Science Center/Discovery Cube (CA) as Vice President, Education.

Supplemental Resources

Download data collection sheets at https://bit.ly/3iYDRnY.

REFERENCES


NSTA Career Center

3 Simple Steps to Find Qualified Science Teaching Professionals

It’s really that simple...

The NSTA Career Center is the premier online career resource connecting employer to talented science teaching professionals. Post your jobs and tap into a concentrated talent pool of professionals at a fraction of the cost of commercial boards.

Visit the NSTA Career Center to learn more

http://careers.nsta.org