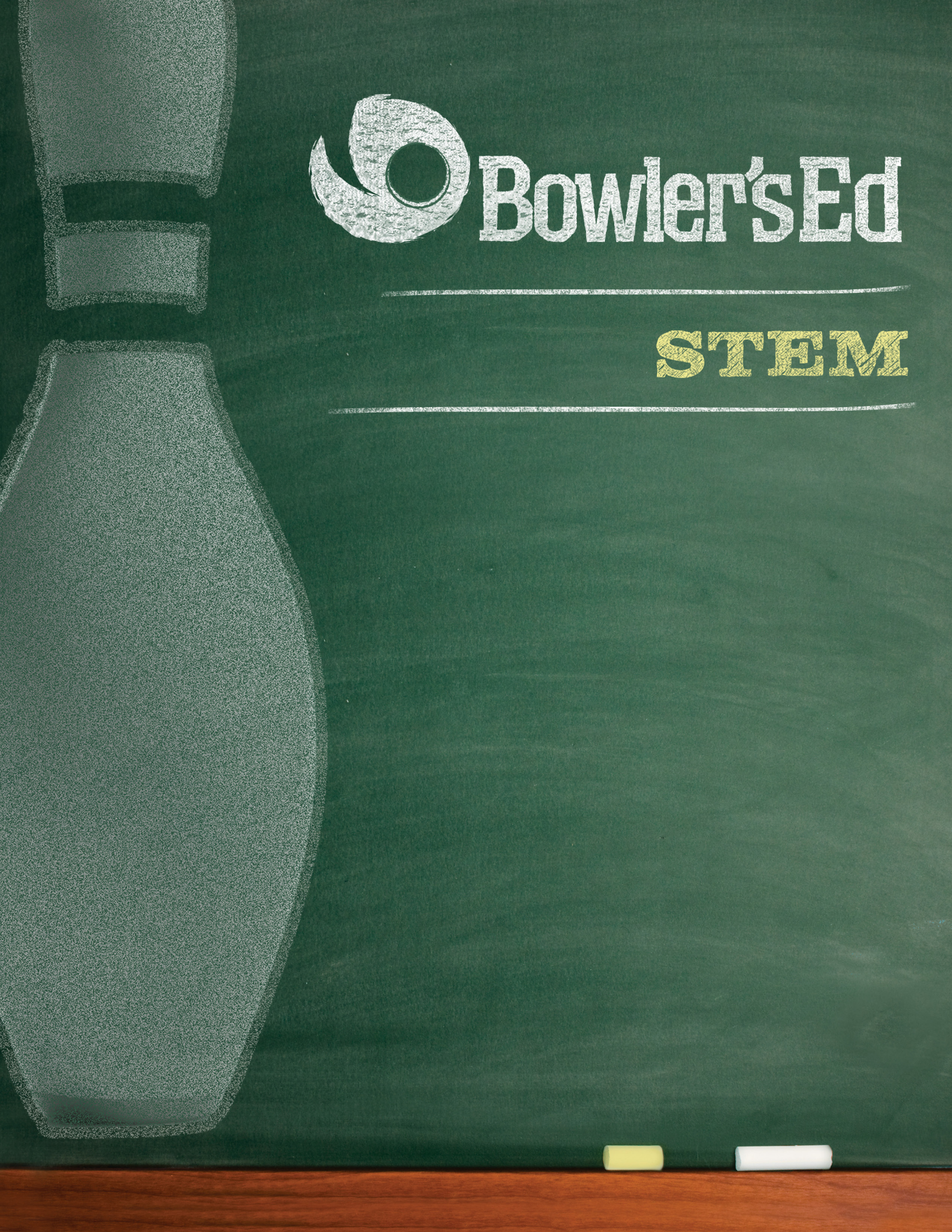

Bowler's Ed
STEM

Activites

Activity #1 – Mass & Distance

Materials Needed:
Varying size marbles
String or tape
Ruler

Procedure 1: Mass and Distance

a. Record the masses of each of the four marbles.
b. On paper, measure a distance of 12 inches using your ruler, and draw a line.
c. Place a small marble on one end of your line, a larger marble at the other.
d. Roll the small marble so that it collides with the larger marble.
e.

f. Measure with your ruler the distance that the larger marble traveled, after the collision.
g. Record your measurement. Do this three times: trail 1, trail 2 and trail 3.
h. Repeat experiment with the larger marble striking the smaller. Push larger marble into smaller one.
i. Record your measurement. Repeat this three times.

Questions:

1. After the collision, which marble traveled farthest?
The collision involving the large marble striking the small marble will produce the largest distance. This is because the larger marble has more inertia, and strikes the smaller marble with the most force. The larger the force applied to an object, the more energy will be transferred, therefore producing the most distance. The small marble will not move the larger marble as far due to the fact it has less inertia.

2. Why do you think this happened?
Students should relate each of the interactions to inertia, force, and energy. They should understand that if an object has a large mass, it has more inertia, and therefore requires more force to get it to move. Because more force is applied, the object also will have more energy, which can cause motion. Larger things are harder to stop (require more force) than smaller things.

3. Does mass have anything to do with how far the marbles traveled?
a. Yes. The largest mass striking the smallest will result in the most distance. The largest mass has the most energy, and provides the greatest force for the smallest marble.

4. Did the hardness of your throw have a possible effect?
“Hardness of throw” is another way of saying “supply of force”. A hard throw has a lot of force; a gentle lob does not supply much force. The greater the force, the more energy stored within the marble.

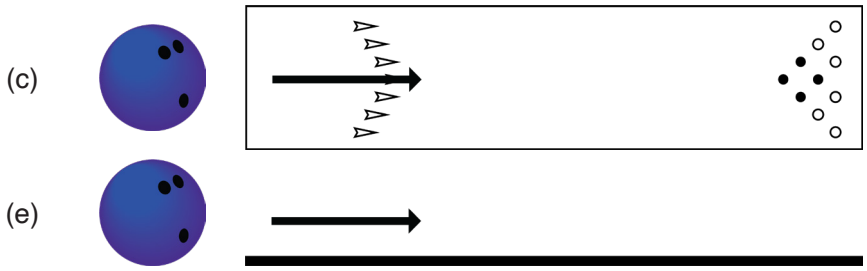
5. Complete the sentence:
The smaller marble travels farthest when struck with the most massive marble because the most **massive** marble has the greatest **inertia**.

Activity #2 - Effects Of Friction

What makes the bowling ball roll best?

* This is best done as a controlled teacher demonstration

a. Place the Bowler's Ed carpeted lane down and tape off a similar lane distance alongside.
b. Make a prediction of how far you think your bowling ball will travel on the gym floor versus the
c. carpeted lane. Do you think the ball will roll easier on the carpet or on the gym surface?
d. Place a ball on the carpeted lane and push it gently down the laneway from a seated position.
e. Record the distance traveled.
f. Place a ball on the gym floor. Push it gently across the marked area of the floor.
   * Have a student at the other end to stop the ball if it continues rolling.
g. Record the distance traveled.
h. Repeat this procedure 3 times for each.



	Distance 1	Distance 2	Distance 3
Carpet			
Gym Floor (not carpet)			

1. On which surface did the ball seem to roll the farthest?

a. Gym floor, since it provides the least amount of friction.

2. What difference did you notice between the floor and the carpet?

a. The carpet prevents the ball from rolling very far when gently pushed. The carpet is rough, and provides more friction. The gym floor is smooth, and does not have as much frictional force as the carpet.

3. Which of the two, carpet or gym floor, provides the least friction?

a. The gym floor, being the smoothest, provides the least amount of friction.

4. Why are bowling lanes made of wood and not carpet?

a. The wood allows the ball to roll quickly and farther than a carpeted surface. It would take too much force to roll a ball down a laneway made of carpet, because the ball will eventually stop rolling on a carpeted lane and never even make it to the pins.

5. How do you think it would differ if the bowling alley were made of sand? Grass? Ice?

a. Sand and grass would be difficult to roll the balls, in that they have a lot of friction: they are not smooth surfaces. Ice, being smooth and slippery, would be another alternative to the wood: both are smooth and provide little friction. This is why we slip on ice if we try to walk on it - it provides us with little friction.

Activity #3 - Force & Speed

Calculate the speed in which the ball traveled and the amount of force applied.

* Calculations of this nature are for students that have knowledge of how to divide numbers

Trial 1:
From a seated position, use both hands to push the bowling ball gently.
When the ball is released from your hands, start the timer.
When the ball reaches the end of the lane, stop the timer.
Record the time it took for the ball to travel down the laneway.

Trial 2:
Increase your force and push the ball it slightly harder.
Record the time it took for the ball to travel down the laneway.

Trial 3:
You may stand up. Using one hand, you may roll the ball quickly.
Record the time it took for the ball to travel down the laneway.

Switch with your partner and repeat the experiment.
Calculate the average speed for both you and your partner.

Calculate speed by dividing the distance in meters by the time in seconds.

Speed = Distance (m) ÷ Time (s)

	Lane Distance	Time Ball Rolled	Partner's Ball Speed (m/s)	Partner #2 Ball Speed (m/s)
Trial 1				
Trial 2				
Trial 3				
Average				

- Determine the length of the laneway with a metric tape measure.
- Have a partner ready with a stopwatch by the side of the lane.

1. On which throw did the ball travel the fastest?

a. Students should respond that the ball thrown quickly traveled the fasted. When they try to roll it fast, it means they are supplying more force. A greater amount of force means they will be providing the ball with more energy. More energy overcomes inertia.

2. On which throw did you apply the most force?

a. The last of the trials, where they threw the ball quickly, supplied the most force.

3. What can you conclude about how hard you throw the ball, and how fast it travels?

a. Students will be able to explain that the harder the ball is rolled, the faster it will travel. This is because they are providing the most force when they try to make it go farthest. The force applied to the ball provides the ball with energy.

Activity #4 - Angles and Collisions

Materials Needed:
Bowler's Ed In-School Bowling Equipment
Gymnastic mats or similar mats for 'bumpers' alongside lane

a. Roll the ball as straight as you can down the laneway.
b. Record how many pins you knock down.
   Repeat this 2 more times.
c. Roll the ball slightly to the left of the front pin. Record how many fall.
   Repeat this 2 more times.
d. Roll the ball slightly to the right of the front pin.
e. Record how many fall.
   Repeat this 2 more times.
f. Roll the ball down the alley so that it bounces off the sides. Observe ball speed after it bounces.
   Record how many pins are knocked down.
g. Repeat this 2 more times.
h. Find the average number of pins knocked down using each method.
   Construct a bar graph of your data.

	Lane Distance	Time Ball Rolled	Partner's Ball Speed (m/s)	Partner #2 Ball Speed (m/s)
Trial 1				
Trial 2				
Trial 3				
Average				

1. Which method knocked down the most pins?
a. Students' responses will all vary, due to how hard they roll the ball. In general, the straight forceful throw will knock down the most pins.

2. Which method knocked down the least?
a. The throw where they have to bounce the ball off the side-rails will knock down the least amount of pins, due to the fact that the ball loses energy to friction and due to the collisions (energy leaves the ball and it transferred to the rail each time it strikes). In these instances, the ball may not be able to roll the total distance to reach the pins since it loses so much energy, or it simply does not have enough force to knock down the pins when it reaches them.

3. What happened to the ball's speed after it bounced each time?
a. The ball's speed will decrease.

4. What happened to the ball's energy after it bounced off of the sides?
a. As energy decreases, speed decreases. Some of the ball's energy is transferred to the side-rails each time it strikes them, causing the ball to loose energy, and therefore loose speed.

References and Continued Learning Resources

References:

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Day, N., and Raymner, M., (1962) How to Improve Your Bowling Athletic Institute. Chicago: Athletic Institute

Boomer Parks Elementary Fieldtrip Curriculum. Elementary Bowling Lesson Activities. Retrieved from
http://www.boomersparks.com/site/Dania/educational/ELEMENTARYv2.pdf

Continued Learning:

Sports Science – PBA's Sean Rash
http://www.youtube.com/watch?v=gY-8BUnSgf4
In this video demonstration from ESPN Sport Science you will learn about velocity, acceleration and the force on a bowling ball and body upon release.

Science Chanel How It's Made – Bowling Ball
http://www.youtube.com/watch?v=cW4H31DS0QY
In this video you will learn about the combination of liquids that made up a bowling ball core, bowling ball and manipulation of bowling balls through construction and design.

Science Chanel How It's Made – Bowling Pin
http://www.youtube.com/watch?v=Y7ekdqyO-yM
Learn about the creation of a regulation bowling pin throughout the entire process. Additionally, you will learn about the weight, height, bowling pin dimensions and creation time.

Time Warp – PBA's Michael Fagan Swing Analyzed
http://www.youtube.com/watch?v=of92oOD6SqQ
In this video, PBA star Michael Fagan has his swing, bowling ball rotation speed and how he creates the speed/velocity analyzed on the lane.