BOWLING

The In-School Way

(With Lessons for Math and Science)

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INTRODUCTION

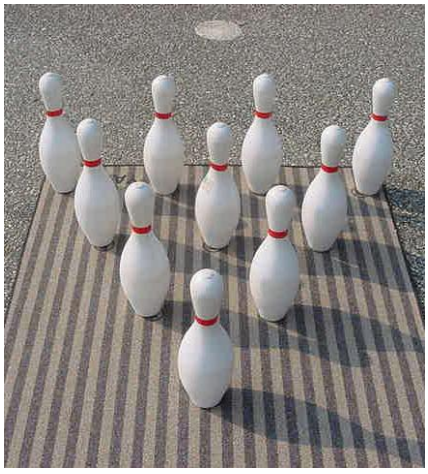
Bowling is successful because almost anyone can participate. It attracts people of all ages, races, religions and economic status. Over the years, bowling has become one of America's most popular individual sport. The casual bowler rarely takes the game seriously and bowls just for fun.

Dutch immigrants from Holland brought their love of bowling to the colonies. The common people of the colonies enjoyed their ninepin game in the alleys behind the taverns. This is where bowling alleys most likely received their name. Now they are called bowling centers. The upper class people bowled on their manicured lawns. The Dutch had a great influence in establishing a permanent site for bowling when they set up America's first bowling lanes in 1623.

Bowling is good exercise for all ages and works 134 different muscles. It does not take a lot of physical strength to become a good bowler. Bowling helps to improve hand to eye coordination.

LET'S BOWL THE IN-SCHOOL WAY

The carpet lanes used in school are scaled down and look just like an actual lane. The carpet lanes even have the alternating light and dark stripes (boards) to help with aiming towards the pins. The pins are the same height as an actual bowling pin, but they are plastic. Some in-school bowling pins have sand in them to give them a little weight. The bowling balls are hollow and made of a heavier plastic. The in-school bowling ball weighs about three pounds. There are different sets of holes in the ball to accommodate different size hands. The holes drilled in the ball are made for the middle finger, ring finger and the thumb. Fingers should fit just inside the holes near the first knuckle.



FOUR-STEP APPROACH

The most common approach in bowling is the four-step approach. To set up for the **approach**, start at the **foul line** and take four steps back. Position yourself for the approach using the **locator dots** on the lane. Hold the ball with your fingers in the holes and your hands together under the ball like you are holding a book. Keep the ball about waist high and start with your feet slightly apart. Now that you are in position, you are ready to start your approach.

Stance for left-handed bowler

Push

Begin your approach by stepping forward with the foot on the same side as your ball hand. At the same time, push the ball away from you towards the arrows on the lane. Right-handed bowlers should push toward the third arrow from the right and left-handed bowlers should push toward the third arrow from the left. Aiming towards the arrows will give you a better chance of hitting the **strike pocket**.

As you step forward with the opposite foot, let the ball swing down by your side and back.

Step

With your third step, swing the ball forward toward the arrows.

.

Swing

Then roll the ball down the lane as you take your fourth step.

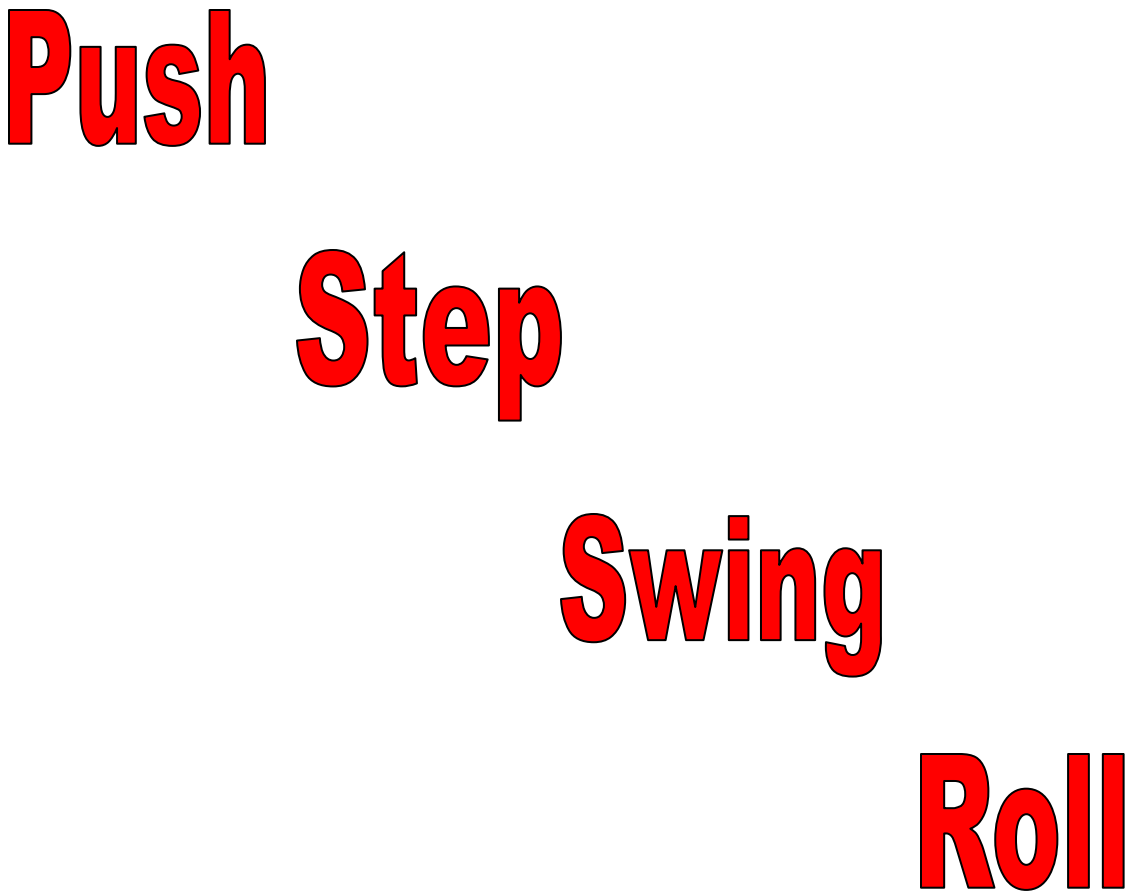
Roll

When you release the ball, your thumb will come out first followed by the other two fingers.

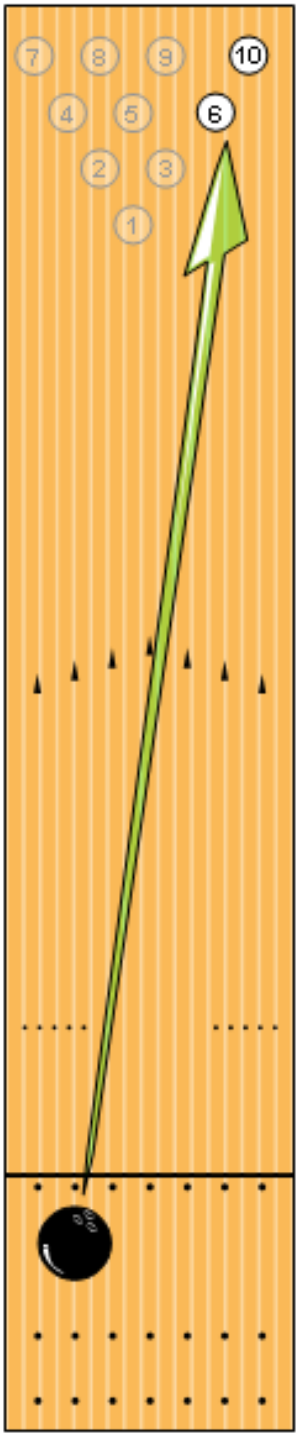
Follow Through

After you release the ball, your palm should be facing up while bringing your hand straight up in the follow-through. You should finish your approach with your arm up and your opposite leg back.

Although these movements will feel awkward at first, they will become easier with practice. Good coordination will allow you to place the ball over the **foul line** without having to force the swing. A good way to remember this approach is to say, "Push, Step, Swing and Roll" as you walk toward the foul line.



PRACTICING FOR SPARES



All bowlers would like to get a strike on their first roll, but that does not always happen. When you leave two or more pins, which are not next to each other, standing, it is a **split**. The hardest spare to obtain is the 7 / 10 split.

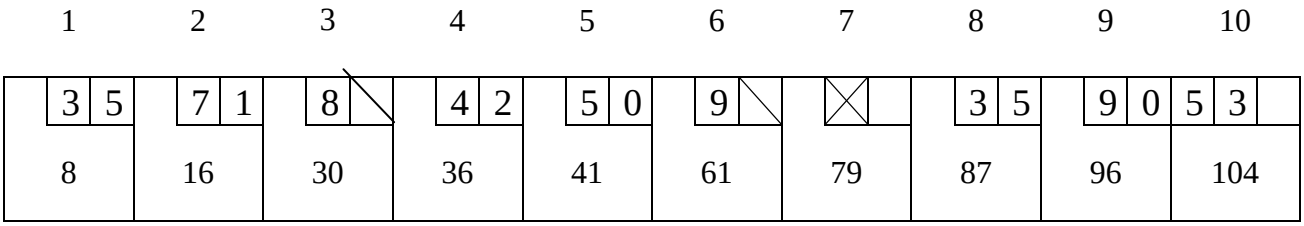
Practicing to pick up a spare will increase your score. There are many different spare combinations. The bowler must remember that the ball itself cannot always knock down the pins. Sometimes you have to hit the pins a certain way so they knock other pins down.

A basic rule to remember in approaching a spare is to line up on the opposite side of the standing pins. If the pins are standing on the right, the bowler lines up on the left. If the pins are standing on the left, the bowler lines up on the right. Setting up the approach this way will give the bowler a better chance of picking up the spare.

Another way to practice picking up a spare is to set up all the pins and only go for the 7 pin on your first roll. Then, only go for the 10 pin on your second roll.

SCORING

The game of bowling consists of ten frames and is played in turns. In each frame, the bowler gets two attempts to knock down all the pins. Keeping score is just a matter of adding. Below is an example of a complete game. Note that when the bowler rolled a strike or spare, he received a bonus.



8	F1
+ 8	F2
16	Running F2
10	Spare F3
+ 4	Bonus F4
30	Running F3
+ 6	F4
36	Running F4
+ 5	F5
41	Running F5
10	Spare F6
+10	Bonus F7
61	Running F6
10	Strike F7
+ 8	Bonus F8
79	Running F7
+ 8	F8
87	Running F8
+ 9	F9
96	Running F9
+ 8	F10
104	Running F10

F = Frame

Running = total number of pins knocked down.

/ = Spare

X = Strike

A spare equals 10 points plus the score (bonus) from the next one roll.

A strike equals 10 points plus the score (bonus) from the next two rolls.

If you bowl a spare in frame 10, you get one extra roll.

If you bowl a strike in frame 10, you get two extra rolls.

The most number of points you can get in any one frame is 30.

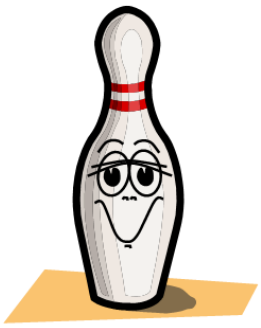
The highest score in bowling is 300.

SCIENCE IN BOWLING

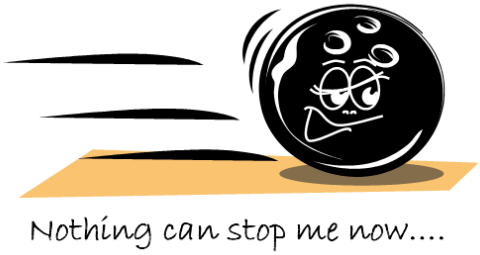
Before we talk about Science in bowling, we need to know some science vocabulary. **Motion** is the act of an object moving from one place to another. A **force** is any pull or push that causes an object to move, stop or change direction. **Friction** is a force that opposes motion when two surfaces rub against each other. **Magnetism** is the force of pushing or pulling between poles of magnets. **Gravitation** is a force that pulls all objects toward one another. **Inertia** is the property of matter that keeps an object moving in a straight line or keeps it at rest.

MOTION

Sir Isaac Newton formulated three laws of motion. The first law being, an object at rest will remain at rest and an object in motion will continue to move at the same speed and in a straight line unless acted upon by an external force. An example of this in bowling is that the pins will remain at rest until the **unbalanced force** of the rolling ball hits them, therefore knocking them over.



I am just sitting here.



Nothing can stop me now....

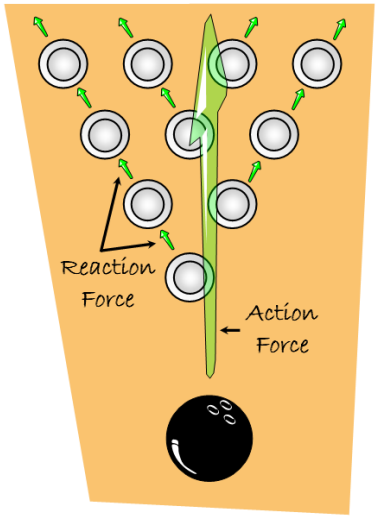
Another example is that when the ball is released, it will continue to roll in the same direction until acted upon by a force. Either the ball will hit the pins, or it will roll off the carpet lane. The combination of the force of the ball hitting the pins and the friction of the ball on the carpet will stop the ball.

When unbalanced forces act on an object, that object will start to move, increase speed, slow down, change direction, or stop. When this change of motion occurs, it is called **acceleration**. This brings us to Newton's second law of motion. An external force acting on an object causes acceleration, the amount being dependent upon the strength of the force and mass of the object. When a bowler lines up for their four-step approach, the first thing that happens to the ball is that it accelerates away from the bowler. Then the ball stops and accelerates on the back swing. Just like a pendulum, the ball accelerates forward as the bowler releases the ball down the lane towards the pins. Remember, the pins are at rest. When the accelerating ball hits the resting pins, it causes them to become unbalanced forces and they accelerate into each other.

I am accelerating!

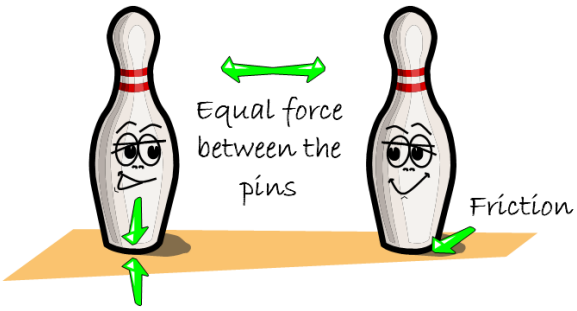
The pin is accelerating.

Newton's third law states that for every action force there is an opposite reaction force. When the ball is rolled down the lane, the ball is the action force to the pins. The falling pins become the reaction force.



FORCES

Forces acting on an object can sometimes balance each other. Forces that are equal in size and opposite in direction are **balanced forces**. An example of a balanced force is two pins standing next to each other. When the forces are equal, the object will remain stopped or continue to move at the same speed and direction. When we see the pins set up at the end of the lane, it seems as if there is no force acting on the pins, but there is. The force of the ground is holding up the pins. The force of gravity is pulling the pins toward the center of the earth. The force of friction is helping to keep the pins from sliding off the lanes.



The pin pushing down is equal to the ground pushing up.

When one force is greater than its opposite force, they are **unbalanced forces**. We rely on the unbalanced forces of the rolling ball to knock down the pins. The force of the rolling ball is greater than the forces of the pins, thus knocking them down. Once the pins start to fall, they become unbalanced knocking each other down. Remember that the ball itself cannot hit every pin; therefore, we must rely on unbalanced forces of the falling pins to get a strike.


The unbalanced force of the ball hits the pin causing it to become unbalanced.

MOMENTUM

Momentum is a measure of how hard it is to slow down or stop an object. When the bowling ball collides with the pins, the momentum the ball loses is equal to the momentum the pins gain.

INERTIA

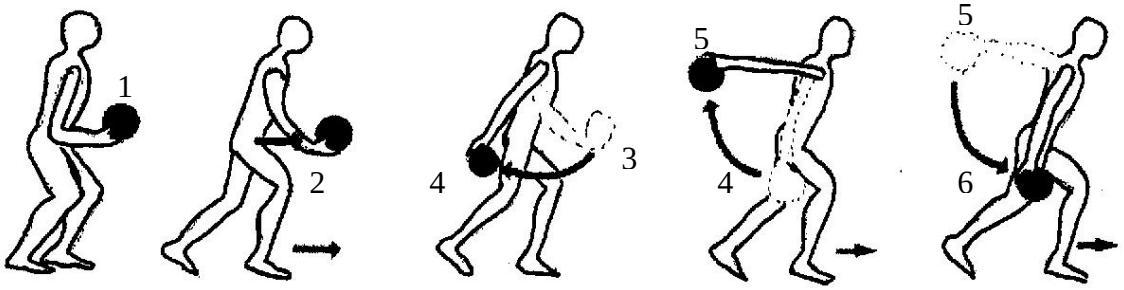
An object's **inertia** resists changes its motion. The inertia of the pins sitting at the end of the lane will resist the bowling ball's inertia. The momentum and force of a rolling ball is greater than that of the pins. This inertia of the ball will knock down the pins. The inertia of the bowling ball, when rolled down the lane, will resist the change in its motion. The ball will continue to roll until acted upon by a greater force.

When a ball is rolled down a carpet lane with nothing in its way, the ball will come to a stop. Why does this happen? The forces of friction and gravity will stop the ball.

ENERGY

There are two basic kinds of energy: energy of position and energy of motion. **Kinetic energy** is energy in use or in motion. Anything in motion has kinetic energy. **Potential energy** is energy that is at rest. All objects have potential energy.

When the bowler holds the ball, the ball has potential energy. When the bowler pushes the ball away from his body, the ball has kinetic energy. The instant the ball stops before the back swing, it has potential energy again. When the bowler begins the back swing, the ball returns to kinetic energy. For a brief second, the ball stops at the end of the back swing, and has potential energy until the bowler swings and rolls it forward down the lane. The ball once again has kinetic energy and continues to roll until it hits the pins. When the ball hits the pins, it causes the pins, which started out with potential energy, to have kinetic energy. The kinetic energy of each pin causes the pins to hit each other, making a chain reaction similar to that of dominos.



1 = Potential 2 = Kinetic 3 = Potential 4 = Kinetic 5 = Potential 6 = Kinetic

MATH IN BOWLING

Based on the game from the scoring page, keeping score can be made into an algebraic equation.

Frame 3

Find the  value of  if **r1**=4

16 + + **r1** = 30

16 +  + 4 = 30

20 +  = 30

= 30 - 20

= 10

16 + 10 + 4 = 30

Frame 6

Find the value of **r1** if = 10

41 + + **r1** = 61

41 + 10 + **r1** = 61

51 + **r1** = 61

r1 = 61 - 51

r1 = 10

41 + 10 + 10 = 61

Frame 7

Find all the possible values of **r1** and **r2** if x = 10.

61 + x + **r1** + **r2** = 79

61 + 10 + **r1** + **r2** = 79

71 + **r1** + **r2** = 79

r1 + **r2** = 79 - 71

r1 + **r2** = 8

Answers:

If **r1** = 8 then **r2** = 0

If **r1** = 7 then **r2** = 1

If **r1** = 6 then **r2** = 2

If **r1** = 5 then **r2** = 3

If **r1** = 4 then **r2** = 4

If **r1** = 0 then **r2** = 8

If **r1** = 1 then **r2** = 7

If **r1** = 2 then **r2** = 6

If **r1** = 3 then **r2** = 5

GLOSSARY

acceleration – when an object changes its motion

approach – the area on which the bowler takes his/her steps toward the foul line; the act of moving to the foul line to roll the ball

balanced forces – forces that are equal in size and opposite in direction

force – any pull or push that causes an object to move, stop or change direction

foul line – the black line separating the land and the approach; it is against the rules to cross this line.

frame – one of the ten turns in a game; a box to write your score

friction – a force that opposes motion when two surfaces rub against each other

gravitation – force that pulls all objects toward one another

inertia – the property of matter that resists an objects change in motion

kinetic energy – energy in use or in motion

locator dots – dots located in the approach area used to properly align the feet

magnetism – the force of pushing or pulling between poles of magnets

momentum – a measure of how hard it is to slow down or stop an object

motion – the act of an object moving from one place to another

potential energy – energy that is at rest

spare – the score for knocking down all pins with two balls in a single frame

split – two or more nonadjacent pins left standing after the first roll

strike – the score for knocking down all the pins with the first ball of a frame

strike pocket – right handed bowlers use the area between the 1^{st} and 3^{rd} pins, left handed bowlers use the area between the 1^{st} and 2^{nd} pins.

unbalanced forces – when one force is greater than its opposite force

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