Science FUN #1 – Momentum

We all see things moving around us. Cars, trucks, dogs, cats, dogs chasing cats…All these things have something in common – they have momentum!

Wait - what is momentum?

It's really simple – momentum is the motion of an object. If an object is moving, it has momentum. If it isn't moving, it does not have momentum. So momentum depends on motion, and the faster an object moves, the more momentum it has.

But momentum also depends on how big something is. Consider this:

You are playing catch with your friend, and you are tossing two balls. One is a tennis ball and the other is a bowling ball. To play, you have to throw the balls at the same speed. Which is harder to throw?

The bowling ball because it has more mass (it weighs more)! So we say the bowling ball has more momentum even though it moves at the same speed as the tennis ball because the bowling ball is bigger.

So momentum depends on two things:

1. **How fast an object is moving**
2. **How big an object is (how much it weighs, or its mass)**

And the important thing here is that objects with lots of momentum are harder to stop than things with just a little.

And so we DEFINE (that is we made it up!) momentum as:

Momentum = mass of an object (how much it weighs) TIMES how fast it's moving.

MOMENTUM WORKSHEET

So let's see if you can figure which has more momentum:

1. A big semi-truck full of logs and a small car are driving side by side on a freeway at the same speed. Which has more momentum? Why?

2. The Michigan Wolverine Football Team is playing their arch rival, Ohio State. Michigan kicks the ball to start the game and players run down the field. Two players, Jumbo and Jim, weigh the same, but Jumbo is running at 5 meters per second and Jim is running at 3 meters per second. Who has more momentum? Why?

MOMENTUM WORKSHEET

Now, let's try and learn more about momentum (and have fun at the same time!). Let's do some experiments!

Experiment #1

You have two balls in front of you – a basketball and a tennis ball. Weigh each ball using the scale. Record the mass (how much it weighs).

Mass of basketball =

Mass of tennis ball =

Now pick each one up separately, hold it up to your chest and drop it so it hits the floor. Both balls will hit the ground with the same speed (trust me on this). Which ball has the greater momentum when you drop it? Why is this? Explain your answer!

MORE FUN WITH MOMENTUM!!

TRANSFER OF MOMENTUM

Now, an interesting property of momentum is that it can transferred from one object to another. Consider this: When you go bowling, you roll the bowling ball down the lane to hit the pins. What happens when the pins are hit? Why does this happen?

Experiment #2

Take the tennis ball and place it on top of the basketball. Hold them at chest height and drop them together (so the tennis ball sits on top of the basketball as they fall down). What happens to the tennis ball that was on top? Why?

ANGULAR VS LINEAR MOMENTUM

But there are different types of momentum! What we've done so far is "linear" momentum where an object moves in a straight line.

But consider this.

What if I take a basketball and roll it on the floor. Does it have momentum?

What if instead of rolling the basketball I spin it like a top. Does it have momentum?

The answer is BOTH balls have momentum as both balls are moving! But the spinning ball has "angular" momentum. It doesn't move in a straight line, but rotates! This creates momentum!

Experiment #3

Now, here's something to remember – things that have momentum want to keep moving in the same direction. If a ball is going left to right on the floor it will keep moving to the right unless you force it to go in a different direction.

The same thing is true for angular momentum! To show this, take a fidget spinner and hold it between your thumb and fore finger. DON'T SPIN THE FIDGET SPINNER! While still holding the fidget spinner, flip it upside down. Was this hard?

Now, while holding the fidget spinner with your thumb and finger, spin it really fast. While it is still spinning (and still holding the spinner!) flip it upside down again. Was this harder than when it wasn't spinning? What happened?