Wizards of Wright

Lesson: Newton's First Law of Motion

Use WOW! Lesson Intro to begin.

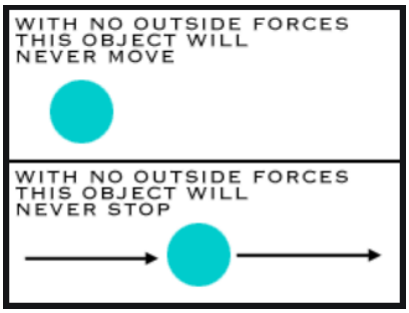
Background Info for Wizards:	Sir Isaac Newton was one of the greatest scientists and mathematicians that ever lived. He was born in England and lived from 1643 to 1727, and was raised by his grandmother. During his college studies he found an interest in math, physics, and astronomy. Newton's ideas have shaped our learning about motion, gravity, the diffraction of light, and forces. His accomplishments laid the foundations for modern science and revolutionized the world.
Materials:	Activity #1: (per pair of students) index card an empty cup a coin Activity #2: (per group of students) bottle ring hex nuts Activity #3: (per group of students) wooden blocks, 6-8 per group plastic cups, 6-8 per group note cards (already punched with a hole, with a string tied through it), @ 7 per group 
Lesson Time: 60 minutes	Introduction: 7-10 minutes Guided Lesson #1: 5 minutes Student Activity #1: 7-10 minutes Guided Lesson #2: 7 minutes Student Activity #2: 7-10 minutes Guided Lesson #3: 5 minutes Student Activity #3: 10-12 minutes Conclusion: 5 minutes
Learning Targets:	Students will learn about: Sir Isaac Newton, Aristotle and Galileo Galilei Students will understand and experiment with Newton's 1st Law of Motion. Students will understand: Gravity, Force and Inertia

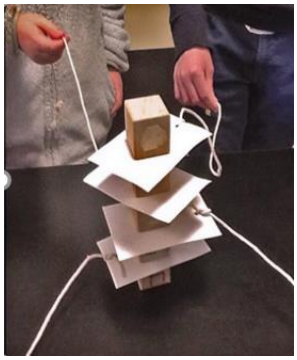
Introduction for Students: 7-10 minutes	Physicists are scientists that study matter - all of the "stuff" in the universe and how that "stuff" moves. Sir Isaac Newton is one of the most famous physicists of all time. He is known for explaining *gravity*. He is also famous for studying and teaching about how stuff moves. These teachings are known as *Newton's Three Laws of Motion*. Sir Isaac Newton is considered to be one of the most famous scientists of all time. But that almost didn't happen. He was born in England in 1643, and his mother wanted him to be a farmer and even took him out of school to make sure that happened. But he wasn't very good at farming and was soon **allowed** to go back to school. He became a scientific leader and even created new areas of study in math and science. People who knew him agreed that he was a genius but that he was also very difficult to work with. Newton was a math and science professor at Cambridge University in England. His discoveries are things that you've probably used or heard about already. **Ask students what they already know about Sir Isaac Newton and his discoveries.** (Their answers and previous knowledge may allow you to skip parts of the intro.) Gravity - Newton is the first scientist to 'discover' gravity, although it's always been there. **Ask students if they can define gravity.** Gravity is the force that pulls an object toward the Earth, or another object. A big object like a planet will have a lot of gravity. Newton realized that gravity explains why planets and stars move the way they do and why things fall down on earth. Legend says that he came up with this theory after he saw an apple fall from a tree. He wondered why it fell straight down instead of in another direction. He realized that a force must be causing it to fall downward. As Newton looked for ways to prove his ideas, he developed a new form of math that is studied in high school - it is called calculus. You'll probably study it one day, too. **Ask students if they have ever seen a telescope that is used to look up at the night sky.** If they have, this is also one of Newton's inventions. Reflecting Telescope - Newton created a reflecting telescope that used mirrors to reflect light (like the light from stars and planets) to make them bigger through the telescope. Almost all telescopes today still use this technology. Most importantly, during his work, Newton came up with the three basic ideas that are applied to the understanding of motion. Other scientists have studied,

	tested and verified these ideas so many times over the years, that now we call them Newton's Three Laws of Motion.
Guided Lesson #1: 5 minutes	Today we are going to look at **Newton's First Law of Motion**. It is called **Inertia**. It describes how a stationary object begins to move or how the motion of an object changes. **Ask students if they already know what Newton's 1st Law of Motion is.** A still object will stay still unless a force pushes or pulls it. A moving object will stay moving unless a force pushes or pulls it. Or stated another way - an object at rest tends to stay at rest, and an object in motion tends to stay in motion, with the same direction and speed. This is called "the law of inertia". What does this mean? This means that there is a natural tendency of objects to keep on doing what they're doing. All objects resist changes in their state of motion. In the absence of a force, an object in motion will maintain this state of motion. Imagine a basketball sitting on a cart. When the cart starts rolling, inertia (an object's resistance to change) actually causes the ball to move backwards when the cart first begins going forwards, as it is resisting that forward motion. When the cart stops, the ball will continue moving because it is resisting the stopping force. Gravity and friction are forces that constantly push and pull the "stuff" on earth. So, when we roll a ball, it slowly comes to a stop. On the moon, where there is less gravity and friction, "stuff" floats, and keeps floating.
Student Activity #1: 7-10 minutes	Show students what to do first. Then, pass out materials to students **in pairs**. They will take turns, but one student should hold the cup for the other (stability). Directions 1. Place an index card (or playing card) on top of an empty cup. 2. Place a coin (or stack of coins) on the card. 3. Flick the card with your finger. 4. Continue until the card is moved out from under the coin(s), and the coin(s) drops into the cup.

	After the students have completed the activity, let's talk about what happened. What does it show us? This activity can be explained by inertia – the tendency of an object to resist a change in motion or rest. The coins (which were at rest) resisted the forward motion of the index cards and fell into the cup below. Every object that has mass has inertia. The more mass an object has, the more inertia it has. It is a directly proportional relationship. The card's force was not strong enough to influence the mass of the coins, so the coins resisted the change in motion due to the coin's inertia. According to Newton's 1st Law, an object at rest will stay at rest unless acted upon by another force. In this case, the force caused by the card is too small to cause a noticeable change in the coins. Collect materials before passing out next set.
Guided Lesson #2: 7 minutes	Newton's Laws are obviously related to the concept of motion: Why does an object move like it does? How does the object accelerate or decelerate? To understand these things, we need to understand the relationship between force and motion. Forces can cause motion. **Ask students to define force.** We can think of a force as a push or a pull. **Ask students if they can tell you anything about Aristotle or Galileo.** Aristotle is known as one of the great thinkers, philosophers and teachers from long ago. He studied and taught about logic, was one of the first to study zoology, and helped develop the scientific method. Galileo was the first person to publish what he observed in space through a telescope. He discovered that the Milky Way is made of many stars. He found four moons around Jupiter. He discovered sunspots, which are dark areas of the Sun. He helped people understand that the Sun is at the center of the Solar System. Galileo worked more at physics than he did at astronomy. A legend says that he climbed the Leaning Tower of Pisa, and dropped cannonballs of different weights, to see which would strike the ground first. Even though their weights were not the same, they hit the ground at the same time. Galileo learned that objects fall to the ground at the same rate, unless things like wind resistance change the rate.

	- This went against what Aristotle had taught. - Most people ignored Galileo's studies and tests until Isaac Newton proved that Galileo was right. - This led to Newton's Law of Gravity. Based on ideas by Aristotle and Galileo, Sir Isaac Newton's First Law of Motion explains the exact connection between force and motion. Aristotle taught that a force is required to keep an object in motion. He believed that the greater the force was on a body, the greater the speed of that body. His theory was widely accepted. Aristotle's theory remained largely undisputed for almost 2000 years, when Galileo came to a different conclusion. - Galileo believed that it was just as natural for a body to be in horizontal motion at a constant speed as it was for it to be at rest. Isaac Newton built upon Galileo's ideas. He taught that an object will stay at rest or in motion in a straight line, with a constant speed, until acted on by a force. The tendency of a body to maintain its position is called inertia. So, Newton's First Law is often called the Law of Inertia.
Student Activity #2: 7-10 minutes	Remembering what you learned in the last activity, let's experiment with Inertia. Show students what to do first. Then, pass out materials to students in small groups (3 or 4 students) or partners. <u>Directions</u> 1. Place a hoop on top of an empty bottle. 2. Place a hex nut, and then a stack, on the top of the hoop. 3. Using one hand, snatch the hoop away quickly so that the nuts will fall into the bottle. 4. Have students perform the activity to see who can get the most nuts at once into the bottle. Ask student groups to explain why this shows Newton's First Law, and where we see Inertia in this activity. Do you remember seeing a magician's act of pulling the tablecloth out from under the dishes? How does this relate? This activity can be explained by inertia. Every object that has mass has inertia. The more mass an object has, the more inertia it has. It is a directly proportional relationship. The hoop's force is not strong enough to influence the mass of the nuts. The nuts resist the change in motion due to their inertia. According to

	Newton's 1st Law, an object at rest will stay at rest unless acted upon by another force. Ask students if they can you use this information to explain the 1st activity with the cards?
Guided Lesson #3: 5 minutes	Let's Review – Now we understand three things: 1. There is a natural tendency of objects to keep on doing what they're doing. 2. All objects resist a change to their state of motion. 3. With no unbalanced force, an object in motion will maintain this state of motion. (This is the same for an object with no motion.) **Ask students to again define force.** A force is a push or pull on an object. **Let's connect force to Newton's 1st Law.** If you're not moving, and you never start moving, you'll never go anywhere. If you are moving, unless something happens, you will keep moving, in that same direction, forever.  You can see really good examples of this idea when you see video of astronauts. Have you ever noticed that their tools float? They can just let go of something and it stays in one place. There is no interfering force to cause anything to change. The same is true when they "throw" something at the camera - the object keeps moving in a straight line. If they threw something when doing a spacewalk, that object would keep moving, in the same direction and same speed, forever. The only thing that could change it or stop it, would be some other force. **Ask students to again define inertia.** Inertia is a measure of the mass of an object. A car has more inertia than a roller skate. When you are in a moving car, you are obviously moving in the same direction as the car. You are also moving at the same speed as the car. Why do we need seat belts and airbags?? Because if the car comes to a sudden stop, you would still be moving in the original direction, at the original speed, towards the windshield. Inertia also explains why we lean towards the opposite direction as a car or roller coaster moves around a steep curve. If it turns right, you lean towards the left; if it turns left, you lean towards the right - because your body continues to move in the straight line it was moving in before the turn.

Student Activity #3: 10-12 minutes	(Same small groups as last activity.) The object of this activity is to attempt to remove the notecards from a tower of wooden blocks without causing enough of a disturbance to the tower's balance to cause it to tumble. If the students create a wobbly, unbalanced tower, it can lead to a discussion on the force causing a disturbance to that balance, which in this case is gravity. Because the cubes want to resist any change in motion (inertia), they will stay in place if the card is pulled out fast enough. Students should try taking each notecard out separately, and once they have done this successfully, they should try again by having everyone in the group pull the cards out at the same time. Can it be done? They'll have to be very precise! <u>Procedure</u> Stack the blocks in a tower, placing a notecard in between each block. Since, there are several students in the group, have them face the pull-strings in different directions.  Starting at the top, pull out the first card, quickly. **Pull straight back, not at an angle.** Continue removing the cards from top to bottom. Try a second time, having the group pull the cards out at the same time. With time remaining, students can try this again, but this time use paper cups instead of wooden blocks. The paper cups have less mass, and therefore less inertia. With less mass and less inertia, they will have less resistance to a change in motion, creating an even greater challenge! Is it easier or harder to keep the object from flying away when pulled? 
Conclusion: 5 minutes	Review what Newton's 1st Law is. Review force and inertia.

information and graphics credited to: http://teachertech.rice.edu/Participants/louviere/Newton/newton.html; https://www.indypl.org/blog/for-kids/science-experiment-newtons-first-law-of-motion; https://betterlesson.com/lesson/634178/newton-s-1st-law-coin-activity-inertia-newton-s-law-expo-1-of-9; https://wiki.kidzsearch.com/wiki/Galileo_Galilei; https://www.pinterest.com/pin/69735494204806661/; https://imagine.gsfc.nasa.gov/educators/programs/swift/classroom/law1_guide.html; http://www.physics4kids.com/files/motion_laws.html; https://www.perkinselearning.org/accessible-science/activities/inertia-tower