Leaders: Downloads are a work in progress. Please feel free to send your ideas and feedback to author Rich Maxwell. Marblekeeper@gmail.com

18 STEM IDEAS

Scientific Experimentation is the practice of making a prediction and performing tests in an attempt to prove or disprove the idea; discover new information, test again, and draw conclusions. And, most important, communicating those "conclusions" for the benefit of others.

Variables are the elements of an experiment that can be intentionally changed or controlled in a scientific experiment. The **Independent variable** is the element you changed to discover its effect. It must be something measurable. The **Dependent variable** is the response you observe because of what you changed. It must be measurable so you can see the results caused by the Independent variable. The **Controlled variable** is the element of the experiment that remains constant; it does not change.

Laws of Motion are the scientific explanations Sir Isaac Newton proposed in the 1700's. Playing with marbles helps us understand these laws of how things move and how gravity and other outside forces affect the movement, or lack of movement, of objects.

Force is a term that refers to the impact, weight, or pressure that effects the location or movement of an object. Gravity, air, surface friction or applied force may all be "influencers". Numerous forces are at work when we play a game of marbles or roll a marble down a track.

Gravity is the constant force that attracts objects toward the center of Earth. It keeps everything from floating into space. The higher a marble is from the ground the stronger the pull of gravity, meaning it will roll faster and farther down a marble track.

Inertia is the tendency of objects to resist changes in their states of motion. Marbles at rest will remain at rest. Marbles that are moving continue moving until they come in contact with an outside force, or gravity slows them down.

Surface Friction is the resistance force or drag that slows down the marble at the point of contact between the marble and the surface as it rolls across a surface. Marbles roll slowly in the dirt or on carpet but very fast on cement or a wood floor. On felt or cloth material a marble roll at a reasonable speed.

Potential Energy is the stored energy a marble has when it is not moving, which is based on mass, size and weight, and its gravitational pull toward the ground. As you raise a marble to the highest point on a marble track, you are building up potential energy.

Kinetic Energy is energy a marble has because it is moving. The faster a marble is moving, the more "kinetic energy" it possesses. When a force such as gravity acts upon the marble at rest, at the top of a marble track, the downward force of gravity causes the marble to start moving and the potential energy converts to kinetic energy.

Transfer of Energy is what happens when a marble hits another marble. The kinetic energy in the rolling marble is passed to the second marble. The second marble receives the energy and moves forward. The first marble stops moving because it has passed its kinetic energy to the second marble.

Classification is a way to make better sense of our world and make things easier to find, identify and study. Observing, sorting and grouping of marbles on the basis of one or more features or characteristics they have in common, is the rock-bottom foundation for marble collecting.

Predicting is what we do in a game of marbles when you estimate where the shooter will go and what impact it will have on the target marbles; Or when you make an educated guess where to set the container off the end of the track. Thinking like a STEMist, we "tap into past experiences or prior knowledge to forecast what will happen next".

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A Circle is a geometric shape with no straight edges or corners. Most marble games are played on a circle because all points on a circle are the same distance from the center; everyone has an equal chance at the marbles in the middle.

Radius is the length of the line from the center of a circle to any point on its edge of the circle.

Diameter is the measured distance across a circle through the center. A four-foot diameter circle will measure four feet from one side to the other. The size of a marble is usually described as the diameter of the marble. For example, a 1-inch marble will measure one inch from one edge of the marble to the opposite edge. A caliper tool is a good way to measure a marble's diameter.

Circumference is the distance around a circle, which you can establish by measuring the distance across the circle, through the center, and multiplying it by 3.14. For example; tTo find out how long a piece of pipe you would need to make a 4-foot hoop ring, you multiply 4 times 3.14.

Propulsion is a means of creating force leading to movement. When a player shoots a marble, the thumb or finger is creating a force, which moves the marble forward. The muscles in the hand are what create the propulsion, similar to how the engines on a plane propels an airplane forward.

Projectile is when a marble is moving freely across the surface or through the air, affected only by thrust and momentum, gravitational pull and surface or air friction.

Acceleration is when a marble changes its speed (state of motion), either when it starts to move forward or slows down. One of the secrets to winning marble games is to know how much acceleration needs to be applied to the shooter marble.

The Metric System, also known as the International System of Units (SI), is a Base-10 system of measurement, built on three main units: meters, liters, and grams. The United States is one of only 3 countries that doesn't not use the Metric System.

Mega Marbles literature uses the Metric System to sizes their marbles because they are manufactured in Guajajara, Mexico.