

MAY THE FORCE BE WITH YOU- ALL ABOUT FORCE AND GRAVITY

Teacher Notes

Any kind of push or pull on an object is a force. We see examples of this everyday in moving cars, falling leaves, spinning tops, and other sights. The same forces that cause the movement that we see everyday also govern how planets move and galaxies form. They play a big part in everything that happens everywhere in the universe, from a pin dropping to a star exploding. When we study force, we look at where different forces come from, how they are applied and how they affect the movement of objects.

Gravity is the attraction between physical objects. You see gravity at work anytime you see an object fall to the ground. All objects exert gravity, the Sun the Earth, you and a single strand of your hair all draw other objects to them to some degree. However, gravity is only noticeable when it is very strong.

In this lesson, we will examine the properties of force and gravity and their effect on our everyday life through a series of hands on activities.

Supplies (for a class of thirty students)

1. A collection of hard and soft, big and small balls-tennis balls, ping pong balls, beach balls, Nerf balls, Wiffle balls, racquet balls- make sure the size, weight and property of the balls are varied
2. Easy to read growth chart to measure ball bounce
3. 10 ball bounce movement data worksheet
4. 10 pencils
5. 250 marbles
6. 30 small resealable plastic bags
7. 12 yardsticks
8. Masking tape

Activity 1: Bouncing Balls

In this exercise, we will be relating properties of materials to their ability to store energy. Energy is in everything. We use energy to do everything we do, from making a jump shot to baking our favorite cookies to sending astronauts into space-- energy is there, making sure we have the power to do it all

Have children work in teams of three. Have each team of girls test the various balls by bouncing them on a hard surface, such as a tile or wood floor. Encourage the girls to observe the properties of the balls (whether they are hard, soft, squishy, light) and decide whether this relates to their bounciness

This experience with bouncing balls can introduce children to the concept of energy. For a ball to bounce, the energy of motion of the moving ball must be stored in the ball or

the floor (by compression) and then returned to the ball as it resumes its motion, now in a different direction, back up. If the ball, or the surface it hits, is not resilient, the ball doesn't bounce well, because some of the energy of motion is taken up by changing the shape of the ball or the floor (as with a carpet where it is pressed down by the ball). Soft malleable balls and surfaces produce the least bounce.

The girls should be encouraged to notice what they can about the balls and to estimate how high balls bounce by using the growth chart in the classroom.

Have the girls record their observations.

Questions to ask:

What balls bounce well? Which don't bounce well? What difference do you see between the balls that bounce well and the balls that don't? Why do you think some balls bounce better than others do?

Please end this activity with a discussion on what the girls learned.

Activity 2: Falling Marbles

In this exercise, we will learn that heavy and light objects fall at the same speed.

Questions to ask:

Do you think the bag with ten marbles would fall faster? Why did you think that it would fall faster? What do you think you will notice about both bags of marbles hitting the floor?

The girls will work in teams of two. Have each team put five marbles in a bag and seal the bag. Then have each team put ten marbles in a plastic bag and seal it. Ask the girls to raise each bag above their heads as high as they can, releasing them at exactly the same time, dropping them onto a carpet. Listen for the moment they strike the floor. They landed at the same time!

One bag weighed more than the other so you would expect for it to fall faster. The force that makes objects fall on Earth is the gravitational pull of the Earth itself. As with any object, the strength of the Earth's gravitational pull is determined by the Earth's mass. Since the Earth's mass is always the same, it exerts the same pull on any two objects that are the same distance from it.

Activity 3: Moving Marbles

In this exercise, we will learn about inertia and how a rolling ball on a smooth, friction free, level surface will roll forever if nothing stops it. Watch what happens when a motionless object gets in the way of a moving one!

Initial questions to ask:

Have the girls make predictions and don't tell them the answers until they have done the experiments. It is better if they derive the conservation of momentum law through play, then through lecture.

The girls will work in teams of five. Have each team tape the yard sticks to the table or floor so that they are parallel and 1/2 ' apart. Put two marbles in the middle of the track between the sticks, several inches apart. Flick a marble so that it rolls and hits another one. Encourage the girls to watch what happens to the two marbles. The one that had been rolling stops. The one that had been still now rolls. The momentum of the rolling marble transfers to the other one, stopping the first and setting the second in motion. Momentum can transfer from one object to another.



Now have the girls put two marbles on the track so they touch and a third several inches away. Flick the stationary marble into the other two. This time the rolling marble stops, the middle one stays put and the third one rolls. The momentum went through the second marble into the third. The amount of momentum is only enough to move one marble at the speed of the first marble. Momentum can pass from one object, through a second and into a third.

Other combinations can be tried, two marbles into three still marbles or three into three still marbles. The same number of marbles set in motion, the same number of marbles will be made to roll. The total amount of momentum at the beginning will stay the same.

Discussion questions:

Did you think both marbles would roll when you hit one marble with another? Why do you think the still marble moved once the other marble hit it? Did you expect one marble or two to move once you hit the three marbles with two marbles?

