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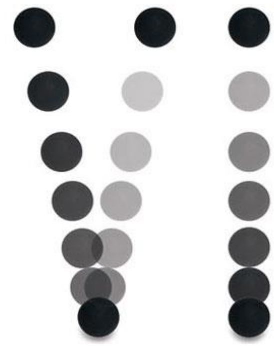
Educational Innovations Inc.®

Choositz Decision Balls

SS-3



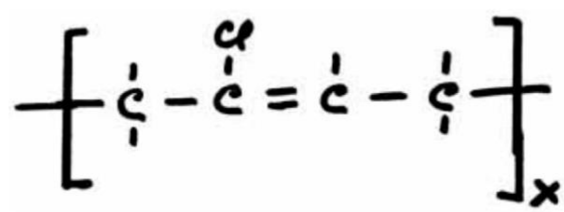
Demonstration:

Two balls which look identical are dropped from the same height onto a hard surface. One bounces to almost the same height, while the other does not bounce at all.

Explanation:

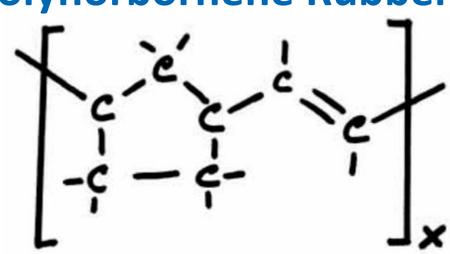
Although the two balls have some similar physical properties, such as size, color, and density, they differ greatly in elasticity. The one which bounces demonstrates an almost perfect elastic collision with a hard surface. Very little of its kinetic energy is converted into heat in the collision. This ball is often referred to as a 'super ball.' The ball which does not bounce demonstrates an almost perfect inelastic collision. Most of the kinetic energy is converted into heat.

Neoprene Rubber



The ball which bounces is made from polyneoprene, which has large chlorine groups to restrict rotation on every fourth carbon in the long chain. Numerous cross links between polymer chains restrict the slipping of one chain past another. With little bond rotation and chain slippage, the energy of the fall cannot easily be converted into heat. To conserve the energy of the fall, the molecules move and then quickly return to their original position. At room temperature, consequently, the ball deforms on impact and then immediately returns to a spherical shape, causing the ball to bounce back to almost the same height as dropped. (Note: This phenomenon is very temperature dependent.)

Polynorbornene Rubber



The ball which does not bounce well is make from polynorbornene, which has a 5-membered ring as part of the chain structure. Although this group restricts the movement, the molecule absorbs most of the energy of a fall. With more degrees of molecular freedom, this polymer does not quickly return to its original shape. Thus, at room temperature, the energy of the fall is absorbed within the molecules in the form of heat. Even cooling this ball in the freezer changes its elastic properties so that a small bounce can be observed.

Classroom Ideas

Activity:

1. Drop each sphere onto a hard surface at a predetermined height.
2. Measure and record the height that each ball reached after it bounced.
3. Cool both spheres (either in the freezer or in a tub with ice and water) for about 30 minutes.
4. Conduct the drop again and note any changes in the spheres.
5. Ask students to explain the effect that cooling may have had on the spheres. What do they predict might happen if you allow the spheres to return to room temperature?

Student Discussion:

Why would scientists develop products made from polynorbornene (the ball that didn't bounce)? What purpose might such products serve?

Items made from polynorbornene would absorb energy rather than re-emit it.

Can you think of some uses for polylnorbornene rubber?

Answers might include manufacturing car bumpers, road barriers, packing material, or the soles of athletic shoes.

NGSS Correlations:

Our Choositz Decision Balls and these lesson ideas will support your students' understanding of these Next Generation Science Standards (NGSS):

Elementary

4-PS3-1

Students can use the Choositz Decision Balls as evidence to construct an explanation relating the speed of an object to the energy of that object.

4-PS3-2
4-PS3-3
4-PS3-4

Students can use Choositz Decision Balls to apply scientific ideas to design, test, and refine a device that convert energy from one form to another.

Middle School

MMS-PS3-1
MS-PS3-3

Students can use the Choositz Decision Balls to apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy.

MS-PS3-4

Students can use Choositz Decision Balls to plan an investigation to determine that the relationships among the energy transferred, the type of matter, the mass, and the change in the average kinetic energy of the particles as measured by the temperature of the sample.

High School

HS-PS3-3

Students can use Choositz Decision Balls to design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.

Take Your Lesson Further

As science teachers ourselves, we know how much effort goes into preparing lessons.
For us, "*Teachers Serving Teachers*" isn't just a slogan—it's our promise to you!

Please visit our website for more lesson ideas:

TeacherSource.com/lessons

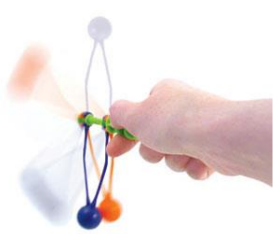
Check our blog for classroom-tested teaching plans on dozens of topics:

http://blog.TeacherSource.com

To extend your lesson, consider these Educational Innovations products:

Seismic Accelerator (SS-150)

Several balls are threaded on a wire. When the apparatus is dropped straight downward onto a hard surface, the top ball can rebound to a height equal to five times the original drop. WOW! Leads into an interesting discussion of what's happened due to the Law of Conservation of Energy.



Newton's Kinetic Yo-Yo (NE-125)

Demonstrate Newton's classic laws of physics! With a flick of the wrist, set the spheres in motion. It really is 'all in the wrist!' As the first sphere swings around, it stops and transfers its energy to the second ball, forcing it to swing around. With practice, students can even make the spheres ricochet off one another above and below the handle.

3-2-1 Blast Off Kit (PHY-321)

Our 3-2-1 Blast Off! workshop on forces and energy has become a standing-room-only event at NSTA conferences. Over the years, hundreds of teachers have asked us to develop a kit that bundles our much-loved demonstrations of things that go "bump" in the day! Kit includes comprehensive teaching instructions and enough hands-on components for up to 10 students. (Safety glasses recommended.)

Dropper Popper (POP-100)

Dropper Poppers are more than just half of a rubber ball. This incredible device seemingly defies the laws of physics by bouncing higher than where you dropped it! Requires a small amount of 'activation energy' to work. It is molded into a very special shape that allows it to store elastic potential energy and then convert it to kinetic energy with a POP when dropped from a low height. Dropper Poppers make a great 'activation energy' demonstration.