

# SMART TUBES™

Ages 5+

## Vice Versa Balls™

One Bounces, One Won't

Used By  
Magicians!

Plus—  
Make Your Own  
Fun Rubber  
Bouncing Balls!

Visit [www.dunecraft.com](http://www.dunecraft.com)  
for more information

Contains Two Rubber Balls and  
One Rubber Ball Making Kit

WARNING: CHOKING  
HAZARD—small parts  
not suitable for children  
under 3 years

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**DuneCraft**



## Vice Versa Balls™

These balls may look and feel like two identical rubber balls, but don't be deceived by what you see. One bounces and the other doesn't! This kit also includes everything you need to make your own bouncing balls!



## How to Make Your Own Bouncing Ball

This kit comes complete with a bouncing ball mold, 2 colors of crystal powder to make 2 bouncing balls, and detailed instructions. Just add water and instantly make your own bouncing balls! See how high they bounce.

## Fun Facts

- Butyl rubber (like in the no-bounce ball) is used to make running shoes that absorb energy. This keeps the runners' knees and ankles healthy by absorbing the damaging shock!
- There are many kinds of materials that "remember" their original shape and return to it after being bent. There are metal shape-memory alloys (SMAs), shape-memory polymers (SMPs), and shape-memory ceramics (SMCs).
- SMAs (metal shape-memory alloys) are currently used commercially and are being used in new medical equipment.
- Used as a magic trick for years!
- You can make your own bouncing balls in minutes.

# Experiments with

# Vice Versa Balls™



1 Drop each ball simultaneously from 12 inches. Which one bounces?

2 Once you determine which ball bounces, drop the ball from 12 inches. Observe how high the ball bounces each time. Does the height increase, decrease or remain constant?

3 Compare the height the bouncing ball reaches after dropping it from 12 inches, 24 inches and 36 inches.

4 Carefully throw bouncing ball at the ground (not too hard- it could hurt someone or knock something over!) Does it bounce higher than the height you released it at?

5 Mark which ball is the bouncing ball and which one is not. Put both balls in a freezer for 10 minutes. Drop each from 12 inches. What happens? Does the bouncing ball still bounce? "Race" each ball down a slight incline. Which wins the race?

6 Try dropping the two balls on a "soft" chair or firm foam surface. Which ball now bounces the highest?

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## How it Works

A ball held in the air has the potential to move when released, which is called potential energy. When the ball is dropped, gravity pulls it towards the center of the earth. The energy of the moving ball is called kinetic energy. When the rubber ball's descent is stopped by the floor, it is slightly flattened as the particles squeeze together. (Imagine if you dropped a ball of soft clay on the ground- would it remain a ball or would it spread out on the ground?) Some of the kinetic energy the ball had on the descent becomes elastic potential energy. What happens next is determined by the properties of the ball.

Though they look the same, each ball is made of a different material. The ball that bounces is made of a natural rubber. The natural rubber polymer's molecules are crossed linked by another substance. This prevents the molecules of rubber to slide past each other when a force is applied to the ball. When it makes contact with the ground, it flattens momentarily before bouncing back to its original shape. The upward energy created when it returns to its normal height causes the entire ball to bounce upward again. The process repeats itself until the ball has no more energy, and comes to a stop.

The no-bounce ball is made of butyl rubber. It acts just like the bouncing ball, except it absorbs more of the energy. The energy that makes the bounce ball bounce again is absorbed by butyl rubber,

so it "dies" almost immediately. This is because there are no cross-links between the butyl rubber. When a force is applied the molecules slide past one another. The energy went into deforming the ball. Butyl rubber is used as shock absorbers in materials such as inserts for runner's shoes and motor mounts.

When frozen, the balls reverse- that is, the ball that is supposed to bounce dies immediately and the ball that isn't supposed to bounce does! The cold temperature slows the movement of molecules in each ball, thus reversing the characteristics. Let the balls return to room temperature, and they will behave as expected.

### Conservation of energy

You should have noticed that the bouncing ball does not bounce higher than it was originally dropped. This is because of Conservation of Energy. This important law of physics states that energy is neither created nor destroyed, it only changes from one form to another. With the bouncing ball, the energy changes from potential energy (before it is dropped) to kinetic energy (while it is moving) to elastic potential energy (while in contact with the ground.) When the ball touches the ground, some of the energy is transferred to the ground. The ball therefore has less energy, and does not bounce as high. When the ball is thrown with some force, however, it gains energy from the floor and is able to bounce higher.