

# Unballeavable Plinko

Grade: 5-6

Time: 1.5 hour

## Activity Overview :

In today's activity we are going to be having fun making bouncy balls! We will investigate how objects use potential and kinetic energy to move, as well as how different substances, like bouncy balls and modelling clay, have different properties. When a bouncy ball is dropped, it converts potential energy into kinetic energy. When it hits a hard surface, a bouncy ball can keep some of its kinetic energy and bounce back up. To learn more about this, we will make different bouncy balls so we can see how they react when we drop them through a Plinko board!

Before we begin think about the following questions:

- Will a ball that is dropped from the top of a building have more or less energy than a ball dropped from close to the ground?
- Will a ball of modelling clay or a bouncy ball bounce higher? Which one do you think will have more kinetic energy after it hits the ground?
- What could you make a bouncy ball out of? Why would you make it out of that instead of something else?

## Materials:

- 1 egg
- Vinegar
- 1 Container with a Lid
- Towel
- Spoon (to remove the egg)
- Baking Soda
- Water
- White glue
- Food colouring
- Flour
- Salt
- Cooking oil
- Cardboard or container lid
- Popsicle Sticks (or golf pegs)
- Writing Utensils
- Tape
- Scissors
- Ruler or Measuring Tape

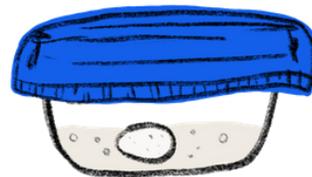
## Activity (Ball #1):

- 1 Pour 3 cups of vinegar into the container.
- 2 Gently place the egg into the container.
- 3 Cover the container with the lid.
- 4 Place the towel over the container to block out any sunlight.
- 5 Put the container in a location hidden from the sun
- 6 Leave egg in the container and wait for the shell to completely dissolve (this could take anywhere from 2-3 days/48-76 hours).
- 7 Remove the egg carefully using a spoon.

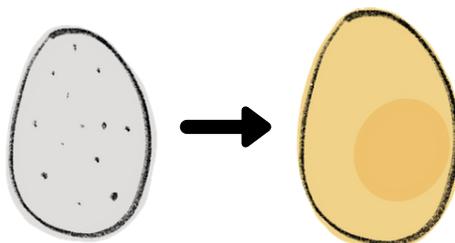
**Step 1**



**Step 2 - 5**



**Step 6**



## Activity (Ball #2):

- 1** Put the  $\frac{1}{4}$  teaspoon of baking soda into a plastic container.
- 2** Add 2 teaspoons of water to your baking soda and mix well. Use 2 teaspoons of salt water instead if you want to make sure your ball isn't sticky. Add a few more drops of water if your mixture is not dissolving.
- 3** Squeeze 3 tablespoons of glue into a separate plastic container. You do not have to measure it precisely.
- 4** Add 1 drop of food colouring to your glue, and use a popsicle stick to stir it until there is no white left.
- 5** Pour your water and baking soda mix into the glue. Use a popsicle stick or spoon to stir your mixture.
- 6** Once it is all stirred up, pick up your mixture and mold it into a ball with your hands. Make sure that there are no cracks or lines in the ball by smoothing them out with your fingers.
- 7** Leave your ball uncovered on a flat surface for 24 hours, or until it is hard. You can reshape your bouncy ball by dabbing some water onto it with your finger and carefully re-molding it.

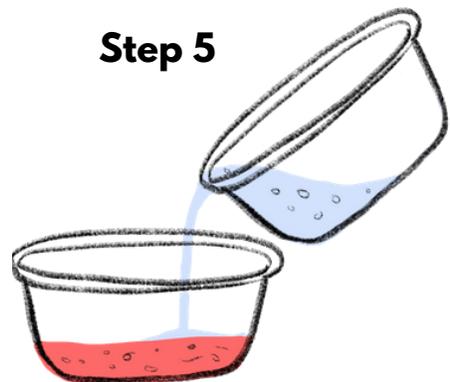
**Step 1 - 2**



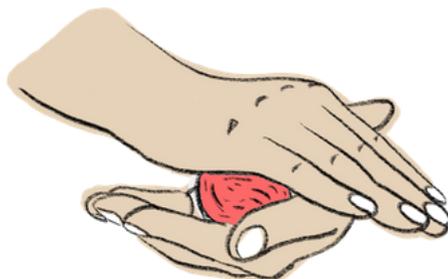
**Step 3 - 4**



**Step 5**



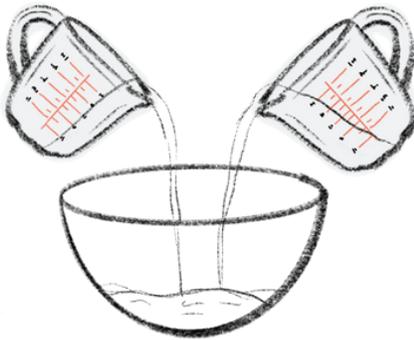
**Step 6**



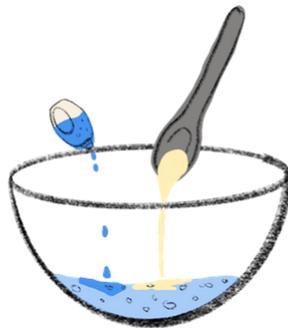
## Activity (Ball #3):

- 1** Combine 1 cup of flour with  $\frac{1}{2}$  cup of salt into a medium sized mixing bowl.
- 2** In a separate bowl, mix  $\frac{1}{2}$  cold water,  $\frac{1}{2}$  tablespoon of oil and 1 drop of food colouring.
- 3** Pour the wet ingredients into the dry ingredients and mix with a spoon until they are combined.
- 4** Squeeze or knead the dough with your hands for 2 minutes (if the homemade dough is too wet, add some flour).
- 5** Store the home-made dough in a sealed container until ready to make the ball and test.

**Step 1**



**Step 2**



**Step 3**



**Step 4**

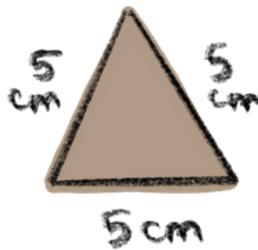
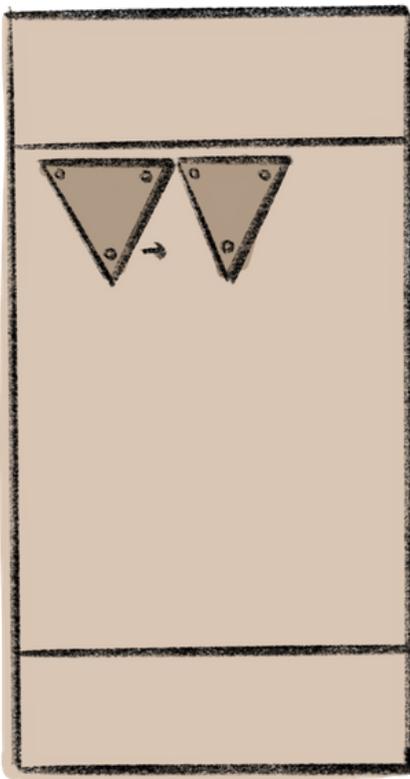


## Activity (Plinko Board):

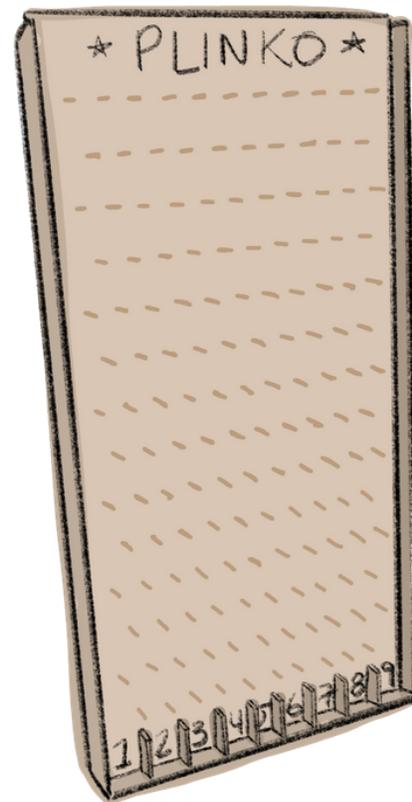
- 1** Cut out a rectangular piece of cardboard that is around 50 centimetres wide and 1 metre long (Feel free to change the proportions of the board if necessary. Keep in mind the size of the balls you made).
- 2** From a separate piece of cardboard, cut out a triangle that has 3 equal 5 centimetre sides. This triangle will be used to create equal spacing between the popsicle sticks on the Plinko board.
- 3** Measure 10 cm down from the top of the cardboard and draw a horizontal line across. Measure 10 cm up from the bottom of the cardboard and draw a line.
- 4** Place one of the triangle edges on the left side of the line. As shown by the arrows, poke 3 holes at the location of each point on the cardboard. Move the triangle to the right so that the left corner of the triangle touches the hole that you just made. You do not need to poke holes at the edge of the cardboard.
- 5** Continue moving the triangle to the right and poking holes until you have 9 holes along the top line.
- 6** Move the triangle down and match the two corners up with two holes in the second row. Poke a hole at the remaining corner. Continue this process until your cardboard is filled with holes that are 5cm apart.
- 7** Stop poking holes once you reach the bottom horizontal line.
- 8** Insert the popsicle sticks halfway into the holes, and tape or glue them in.
- 9** In order to create sides so that the balls do not fall out, cut out 2 long pieces of cardboard that are the same length as your board. Tape these pieces onto each side of the board.
- 10** Cut out a piece of cardboard that is 50 cm long and tape it to the bottom of the board.
- 11** Cut out smaller pieces of cardboard to create slots for the balls to fall in.
- 12** Feel free to get creative here when labelling the slots (Draw pictures, create prizes, create a point system)

- 13** In order to prop up the board on a slant lean it against something that is sturdy. For example, against a chair using the seat as the middle support or against a wall. Depending on the thickness of the cardboard, you may need a support halfway down the board.
- 14** Write something fun at the top of your board above the first line of holes. Then feel free to decorate your board as you like!

## Step 1 - 6



## Step 7 - 14



### Testing the Balls on the Plinko Board

\*Note: Testing the balls on the Plinko board could potentially get messy and therefore it may be a good idea to have a cloth ready to wipe up the mess. The board could also be set up outside.

1. Ensure that you have set up your pinko board and it is sturdy
2. Gather the 3 different types of balls that you have made and place them beside the board.
3. Go ahead and place the ball at the top of the board and drop it down. Test out each ball and make your observations.

## Engineering and Science Connections

**Potential energy** is energy that is caused by the position of an object. When an object is up high, it has more potential energy stored up because it will be able to fall farther. For example, a soccer ball on the top of a hill has more potential energy than a basketball at the bottom of the hill because it can roll down the hill, while the basketball has nowhere to go. Likewise, a ball on the top of a building will have more potential energy than a ball that is close to the ground.

When an object is dropped, its potential energy turns into kinetic energy. **Kinetic energy** is the energy of movement, so anything that is moving has kinetic energy. When the two balls are dropped, the ball from the roof will have more kinetic energy as well. This is because the ball from the roof had more potential energy to convert to kinetic energy.

When you dropped your bouncy balls into the Plinko board, each one acted differently. If you dropped every ball from the same height, they all should have a similar potential energy. However, some of the balls may have been better at keeping their kinetic energy. For example, the dough probably didn't bounce as much as the other balls, which means it kept less of its kinetic energy when it hit a hard surface.

### An Eggcellent Fact

The eggshell contains a base called **calcium carbonate**, which reacts with the **acid** in vinegar called **acetic acid**. The acetic acid breaks up the calcium and carbonate which then dissolves the shell. When they react they produce **carbon dioxide** gas which is why you see **bubbles** on the shell!

## Extensions

- Design a better Plinko board, or modify the one you just made.
- Find some objects around your house that you can test out in your Plinko board. Compare how they act to the balls you made.
- If the balls get stuck, alter your Plinko board to prevent this.

**Share your creations!** 

Don't forget to share your experiments and creations with us! We would love to see what you've made. You can Email us at: [esqinfo@uwaterloo.ca](mailto:esqinfo@uwaterloo.ca) or send us a message/tag us on our social media!

**Facebook:** @uwengoutreach    **Twitter:** @UWEngOutreach    **Instagram:** @uwengoutreach

**Thanks for exploring, discovering, and learning with us!**

# 3, 2, 1 Done!

**3 - Write or draw 3 things you learned from this activity**

**2 - Write or draw 2 things you found super interesting or cool and want to learn more about**

**1 - Do you have any questions about the activity? Did something make you wonder...what if? how? or why?**