

# Why Won't the Ketchup Pour?

STUDENT ACTIVITY PAGE



## BEFORE YOU BEGIN



Have you ever had difficulty pouring ketchup from a bottle? You probably tried hitting the bottom of the bottle and found nothing came out. Ketchup is an example of a **non-Newtonian fluid**. Sir Isaac Newton was a famous eighteenth century physicist, best known for his work on gravity. He also described the properties of fluids. Water is a good example of a liquid that behaves like a Newtonian fluid. Ketchup and quicksand are two examples of non-Newtonian fluids that don't behave like water.

In this activity, you will produce two **colloids**, which are non-Newtonian fluids. A colloid is a mixture that is made up of particles suspended in a fluid. The particles are too large to form a solution, but small enough to remain suspended in the solvent. You will explore the properties of these fluids, learn how to get ketchup out of a bottle, and find out what to do if you ever fall into quicksand.



## MATERIALS

- Newspaper
- 100-ml graduated cylinder
- 10-ml graduated cylinder
- 25-ml graduated cylinder
- Stirring rod or spoon
- Mixing bowl
- Teaspoon
- 500-ml beaker
- Food coloring
- Cornstarch
- Water
- Liquid laundry starch
- Sodium chloride (table salt)
- White glue
- Paper towels



## PROCEDURES

Record your observations and answers to questions in the Data Collection and Analysis section.

### PART I

1. Spread out the newspaper on the tabletop and work on it to keep the tabletop clean.
2. Use the 100-ml graduated cylinder to put 250 ml of cornstarch into the mixing bowl.
3. Add two drops of food coloring to the cornstarch.
4. Use the graduated cylinder to measure 125 ml of water and slowly add the water to the cornstarch, a little at a time. Mix the cornstarch and water together with a stirring rod until all the cornstarch is wet.
5. Continue to add water slowly and mix until the cornstarch has the consistency of thick ketchup. This is "slime"!

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6. Scoop up the mixture with your hands and roll it into a ball. Perform the operations in Part I of the Data Collection and Analysis section to the ball of "slime" that you have made and describe its properties.

**PART II**

7. Place 30 ml of white glue into a beaker.
8. In another beaker, add 3 ml of sodium chloride, then 60 ml of liquid laundry starch, and stir thoroughly.
9. Pour the sodium chloride-starch mixture into the beaker of glue and stir.
10. Over the sink or a large bowl, pour the mixture into your hand and squeeze out the extra liquid. Be careful not to drop this colloid.
11. Knead the colloid until it forms a smooth ball.
12. Perform the operations in Part I of the Data Collection and Analysis section to your colloid ball and describe its properties.

**DATA COLLECTION AND ANALYSIS****PART I**

- (a) Holding the ball in your hand, gently tap it with a spoon.
- (b) Holding the ball in your hand, tap it forcefully.
- (c) Let the ball stay in your hand for several minutes; then, quickly squeeze the ball.
- (d) Put the ball back into the mixing bowl and stir it with the stirring rod or spoon.
- (e) Bounce the ball on the table.
- (f) Stretch the ball.
- (g) Pull the stretched ball quickly.
- (h) Reform the ball and place it on the table. Leave the ball on the table for several minutes and then observe its shape.
- (i) Press the ball onto a piece of newspaper, lift it, and observe the part that was pressed onto the newspaper.

**PART II**

- (a) Based on the above tests, describe the properties of the "slime" that you made in Part I.  
\_\_\_\_\_
- (b) Based on the above tests, describe the properties of the colloid that you made in Part II.  
\_\_\_\_\_
- (c) Compare the effect of stirring upon each of the substances you made.  
\_\_\_\_\_  
\_\_\_\_\_

# TESTING RESULTS OF "WHY WON'T THE KETCHUP POUR?"

Type of Test	Slime Ball	Glue Ball
Gentle spoon tap		
Forceful spoon tap		
Quick squeeze		
Stir in <sup>cup</sup> bowl with rod or stick		
Bounce on table		
Stretch the ball <u>slowly</u>		
Pull stretched ball <u>quickly</u>		
Reform ball. Let sit on table for several minutes		
Press onto newsprint		

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### CONCLUDING QUESTIONS

1. Prepare a chart comparing the properties of your two colloids.
2. How are these fluids like a liquid? \_\_\_\_\_  
\_\_\_\_\_
3. How are these fluids like a solid? \_\_\_\_\_  
\_\_\_\_\_
4. How did these colloids differ? \_\_\_\_\_  
\_\_\_\_\_
5. Viscosity is a fluid's resistance to flowing freely. Which of the two colloids was most viscous? Explain your answer. \_\_\_\_\_  
\_\_\_\_\_
6. Which of the two colloids was most like ketchup? \_\_\_\_\_
7. Based on what you learned in this activity, why do people have difficulty pouring ketchup? \_\_\_\_\_  
\_\_\_\_\_
8. Quicksand is a non-Newtonian fluid that gets more viscous when force is applied to it. Based on this activity, what should a person who falls into quicksand do to get out? Explain your answer. \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
9. You would like to sell one of your colloids as a children's toy. Write a commercial to sell this product. \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_



### Follow-up Activities



1. Research and write a report for the class about the properties of colloids.
2. Pour about 500 ml of ketchup into a 600-ml beaker. Drop a steel ball into the ketchup from a height of 3–4 cm and time how long it takes to reach the bottom. Stir the ketchup for 1–2 minutes and repeat the ball drop. Compare the time it takes before and after stirring the ketchup for the ball to reach the bottom. Explain the results of your investigation.
3. Research and write a report for the class about thixotropy.
4. Research and write a report about dilatancy.

