Is it a Liquid or a Solid? It's Silly Putty!

Silly Putty is a classic children's toy that many of us have played with. Here we will explore some of its more unusual characteristics. For instance, it bounces like a rubber ball, but if you hit it with a hammer, it will shatter like glass. If you leave it in its egg or on the table, it will flow like a liquid to form a puddle. So, is Silly Putty a liquid or is it a solid? Give up? It's both! It just depends on how you play with it. This is an example of a broad class of material known as viscoelastic liquids.

What you will need to get started

- Silly Putty eggs
- Probes – finger, plastic knives
- Clean up - What clean up? It's silly putty. It cleans itself up

Let's experiment!

1. Watch silly putty flow by dividing a Silly Putty into three equal sized pieces and rolling the Silly Putty into three balls. Set one aside for 1 minute, another for 30 minutes and final one for a couple hours. It's a good idea to prepare this ahead of time as it is a very slow experiment to watch in real time.

2. How are the three different Silly Putty balls different? How does their shape change with time? How far have they spread? How is this different from a drop of a different liquid like water or honey?

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Let's keep experimenting

3. Stretch the silly putty between your hands and let it go. Does it remain stretched? Does it sag? Try stretching it at different speeds?

4. Ball up the Silly Putty and bounce it on the ground. Does it bounce? Does it stick to the ground? Is it better or worse than a superball?

5. If you have a hammer, hit the Silly Putty. What happens? If nothing happens, hit it faster? Still nothing, put the Silly Putty in the freezer, get it cold and try again.

6. Using a knife, cut the silly putty into small pieces. Now, use your fingers to cut the silly putty. Are you able to get the same sharp corners?

7. Look back at the Silly Putty that has been sitting for an hour. So, is it a liquid or is it a solid?

How does it work?

Silly Putty is primarily made from a polymer called polydimethylsiloxane (PDMS). Polymers are very large molecules which can have thousands or even millions of carbon molecules connected together to form a long chain. Think about a piece of spaghetti or a length of rope. In the case of Silly Putty, these polymers are wrapped around each other and entangled with each other to make a bit of a molecular mess. If you deform the Silly Putty slowly, the polymer chains can slowly slide past each other as they unentagle and the Silly Putty tends to act like a very viscous (thick) liquid. This happens when the Silly Putty is placed on the table and allowed to flow. If you deform the Silly Putty quickly, the polymer chains don't have time to slide past each other and instead they deform and stretch acting like molecular rubber bands and making Silly Putty act like an elastic solid. This is where the name viscoelastic fluid comes from. It is part viscous liquid and part elastic solid!

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