

# Harvard Researchers Develop a Liquid with “Intelligence”

## Description

Researchers from Harvard John A. Paulson School of Engineering and Applied Sciences have developed a programmable **metafluid** that demonstrates the ability to transform its properties in response to pressure. The distinct characteristics of this material include a changeable **viscosity**, optical transparency, the ability to shift from a Newtonian to a non-Newtonian fluid, and changeable springiness.

The **metafluid** is made up of a suspension of tiny **elastomer** spheres that buckle under pressure, causing significant changes to the fluid's characteristics. The team envisions potential applications in robotics, optical devices, and shock absorbers that can intelligently **dissipate** energy depending on the impact's intensity.

In contrast with solid metamaterials, metafluids have a unique capacity to flow and adapt to the shape of their container. The research team utilized a scalable **fabrication** technique to produce hundreds of thousands of these highly-deformable spherical capsules, filled with air and suspended in silicon oil. The capsules collapse under pressure to form a lens-like half-sphere and return to their spherical shape when the pressure is removed.

The team demonstrated its programmability by designing a hydraulic robotic gripper that used the metafluid to adjust pressure and safely pick up objects. This new fluid technology **eliminates** the need for additional programming or sensing.

The metafluid also exhibited a change in optical properties when exposed to different pressures, helping the liquid transition from **opaque** to transparent, a feature that could be used in e-inks to change color based on pressure. The research team is now looking into the **acoustic** and **thermodynamic** properties of the metafluid, broadening the scope for its potential applications.

## Vocabulary Insights:

- **Metafluid** /m?t?flu??d/ (noun): A fluid with programmable properties that can change in response to external stimuli.
- **Viscosity** /v??sk?s?ti/ (noun): A measure of a fluid's resistance to flow.
- **Elastomer** /??læst?m?r/ (noun): A polymer with viscoelasticity, meaning it has both viscosity and elasticity.
- **Fabrication** /?fæbr??ke???n/ (noun): The process of making something, typically involving the assembly of parts or materials.
- **Dissipate** /?d?s?pe?t/ (verb): To cause to spread thin or scatter and gradually vanish.
- **Eliminate** /??l?m?ne?t/ (verb): To completely remove or get rid of something.
- **Opaque** /o??pe?k/ (adj.): Not able to be seen through; not transparent.
- **Acoustic** /??ku?st?k/ (adj.): Relating to sound or the sense of hearing.
- **Thermodynamic** /???rm??da??næm?k/ (adj.): Relating to the relationship between heat and other forms of energy.



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## Vocabulary List:

1. **Cancellation** // (noun): The act of calling off or postponing an event.
2. **Refunded** // (verb): Given back money that was paid.
3. **Transparency** // (noun): The quality of being open and honest.
4. **Metafluid** // (noun): A fluid with programmable properties that can change in response to external stimuli.
5. **Viscosity** // (noun): A measure of a fluid's resistance to flow.
6. **Elastomer** // (noun): A polymer with viscoelasticity meaning it has both viscosity and elasticity.

## Vocabulary quizzes

### Multiple Choice ( Select the Correct answer for each question. )

1. What is the term for the act of calling off an event or reservation?  
Option: Refund  
Option: Transparency  
Option: Cancellation  
Option: Reassurance
2. Which word means existing in large quantities?  
Option: Vegetarian  
Option: Abundant  
Option: Substantial  
Option: Elastomer
3. What term is used to describe objects related to the sky or outer space?  
Option: Composition  
Option: Crucial  
Option: Celestial  
Option: Etiquette
4. In terms of space what does the term "distance" refer to?  
Option: Amateur  
Option: Elliptical  
Option: Kombat  
Option: Distance
5. Which term refers to the resistance of a fluid to flow?



- Option: Metafluid
- Option: Viscosity
- Option: Elastomer
- Option: Asteroid

6. What word means of considerable importance size or worth?

- Option: Vegetarian
- Option: Substantial
- Option: Debate
- Option: Rumors

7. What is the process of giving someone their money back after cancellation or return?

- Option: Reassurance
- Option: Humiliation
- Option: Reimbursement
- Option: Surprises

8. What term describes a character whose gender has been changed from the original?

- Option: Kombat
- Option: DLC
- Option: Gender-swapped
- Option: Surprises

9. What word is commonly used to describe unauthorized release of information?

- Option: Vertebrate
- Option: Humiliation
- Option: Spectacle
- Option: Leak

10. Who are scientists that study celestial objects such as stars planets and galaxies?

- Option: Accreted
- Option: Astronomers
- Option: Composition
- Option: Crucial

**Gap-Fill ( Fill in the blanks with the correct word from the vocabulary list. )**

11. If a product is returned the customer may receive a \_\_\_\_\_.

12. Businesses often strive for \_\_\_\_\_ in their operations to build trust with consumers.



13. Good communication is \_\_\_\_\_ in maintaining healthy relationships.
14. Being publicly embarrassed can lead to feelings of \_\_\_\_\_.
15. Life is full of unexpected \_\_\_\_\_ both good and bad.
16. Interest on a loan is \_\_\_\_\_ over time.
17. The \_\_\_\_\_ of a painting can greatly affect its overall impact.
18. Someone who does not eat meat may be described as a \_\_\_\_\_.
19. A healthy \_\_\_\_\_ can lead to new perspectives and understanding.
20. Understanding social \_\_\_\_\_ is important for navigating various situations gracefully.

**Matching Sentences ( Match each definition to the correct word from the vocabulary list. )**

21. Rubber is an example of a material classified as an due to its elasticity and resilience.
22. The grand fireworks display was a dazzling that left the audience in awe.
23. An is a rocky body that orbits the Sun often found in the asteroid belt between Mars and Jupiter.
24. An photographer captured stunning images of the night sky.
25. Many galaxies have an shape rather than being perfectly round.
26. Scientists are researching the properties of that exhibit unique flow behaviors.
27. Players engage in intense virtual battles in the game .
28. Many gamers eagerly await new downloadable content known as to enhance their gaming experience.
29. Celebrity gossip columns are often filled with juicy about famous personalities.
30. The doctor took the time to the patient that the surgery would go smoothly.



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## Answer

**Multiple Choice:** 1. Cancellation 2. Abundant 3. Celestial 4. Distance 5. Viscosity 6. Substantial  
7. Reimbursement 8. Gender-swapped 9. Leak 10. Astronomers

**Gap-Fill:** 11. Refund 12. Transparency 13. Crucial 14. Humiliation 15. Surprises 16. Accrued 17. Composition  
18. Vegetarian 19. Debate 20. Etiquette

**Matching sentence:** 1. Elastomer 2. Spectacle 3. Asteroid 4. Amateur 5. Elliptical 6. Metafluid 7. Kombat 8.  
DLC 9. Rumors 10. Reassure

## CATEGORY

1. Sci/Tech - LEVEL5

## POST TAG

1. elastomer spheres
2. fluid dynamics
3. optical properties
4. pressure-responsive materials
5. programmable metafluid
6. robotic gripper
7. scalable fabrication
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