

SCIENCE SPECTRUM MAGAZINE

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at ISF

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SCIENCE SPECTRUM

MAGAZINE



BIOPLASTICS

VOLUME NO. 1 • OCT

EDIBLE WATER BOTTLES

Edible Water Bottles: An Alternative to Plastic Bottles

Abstract:

This world is increasingly dependent on plastic to fulfill its everyday, single-use requirements. Yet many fail to realize that our planet cannot take it much longer. Plastic bottles are vastly produced, 50 billions of which come from the U.S alone [1]. Being at the forefront of our everyday lives, plastic bottles are changing the planet for the worse. As a result of these significant numbers, scientists had started research for bioplastics many years ago. Finding a complete replacement for everyday plastic has been taking years, yet a quick solution to lower plastic production has become a necessity. Using the concept of specification, a prototype of a famously used technique in molecular gastronomy, was created. Researchers found that having mouthfuls of water encapsulated in a jelly-like membrane might provide a quick and easy water supply, such as for marathon runners or at other sporting events. Using these edible water bottles in such cases would not only decrease the amount of plastic waste produced but would also be more cost-effective. All of this would be possible because the edible water bottles are easily biodegradable and low cost [2].

Introduction:

It is estimated that every year, between 4.8 and 12.7 million metric tons of plastic end up in oceans [3]. 80% of the ocean is polluted by land-based sources and it is estimated that 60 to 65% of it is plastic. By this annual increasing rate of pollution, scientists expect the sea levels to

rise by 19 inches by 2050 [1]. This will lead to some marine animals migrating, while others will end up perishing. The key reason behind it is that there will be more plastic waste than fish in the ocean.

Plastic water bottles are considered as one of the major sources of pollution in our daily life. There are many different types

of plastic, which is lightweight, water-resistant, and most important of all, inexpensive and easily mass-producible. All these characteristics have allowed it to be for single and cheap use. Therefore, water bottles are widely found around the world. And since plastic bottle recycling bins are not found everywhere, people tend to simply trash their water bottle anywhere.

Plastic is recycled in only 9% of its volume; the remainder pollutes the earth and harms the ocean animals [1]. Scientists are working feverishly to find a solution to not only plastic water bottles, but to all aspects of pollution sources.

Studies show that 1 million plastic bottles are bought around the world each minute [4]. So, by considering the amount of energy that is used to manufacture these bottles, the carbon emitted due to their shipping, and the numerous issues that surround disposing them, plastic bottles do not seem like to be a good longterm product.

Finding a better way to substitute this major cause of pollution is a

must especially considering how heavily the world is dependent on plastic products, mainly plastic bottles. It is estimated that the United States has produced around 37.83 million tons of plastic in 2010, 275,00 tons of which ended up as litter [3].

Instead of banning plastic water bottles or forcing people to always carry around a reusable water bottle, researchers came up with an interesting solution: "The edible water blob". An alternative to carrying a water bottle is to simply buy a sphere containing water surrounded by a jelly-like membrane made up of algae and calcium chloride. This squishy, and gel-like vessel for liquids can decompose within four to six weeks if it will not be consumed.

Researchers believe that this environmentally friendly packaging can carry any form of liquid such as soft drinks, liquors or even cosmetics. Its production costs less than 2 cents to manufacture [2]. And The molecules stick together in a vast network, decreasing their flexibility and allowing them to be more rigidly bonded together.

Methodology and specifications:

In 2014, a group of design students in London have created an edible water blob prototype called "Ooho". Afterward, Rodrigo Garcia González and Pierre-Yves Paslier have founded a laboratory called "Skipping Rocks Lab" in which well-known culinary technique called "spherification" was used to produce edible water bottles. In this process, an orb of frozen water was submerged in a calcium chloride solution, causing a gelatinous layer to form around the liquid. Then, the sphere is immersed in brown algae extract or sodium alginate solution, creating another strengthening layer.

As a part of the general process, there are two essential components concerned with spherification: alginate strands - found in the additive sodium alginate - and calcium ions, which come from calcium chloride. The strands of alginate are fairly flexible and soluble in liquid when sodium ions (Na^+) are bonded to the oxygens as it is represented in figure 1.

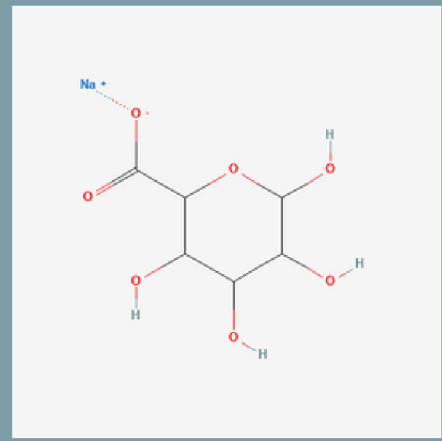


Figure 1: Sodium alginate molecule.
Ref.: <https://pubchem.ncbi.nlm.nih.gov>

When the sodium alginate solution is shifted into the calcium chloride bath, the calcium ions replace the sodium ions at the same time that they bond with the alginate strands. Calcium ions have a positive two charge (Ca^{2+}), and thus must make two bonds to attain stability (Figure 2).

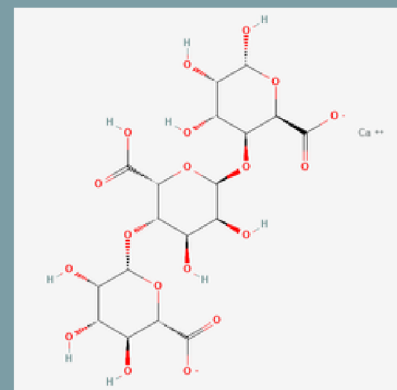


Figure 2: Calcium ion bonding to the alginate molecule.

Ref.: <https://pubchem.ncbi.nlm.nih.gov>

This structure forms the thin gel membrane [5].

Results and discussion:

Since Ooho researchers have customized these edible orbs suitable for other liquids than water. Plastic bottles used for soft drinks could be easily substituted. As regarding their transportation, researchers explain that "smaller spheres can be bundled inside a larger sphere", representing the cells in a pomegranate [2].

In the 2019 London Marathon took a huge step towards sustainability and have replaced more than 200,000 plastic water bottles by "Ooho" edible water pods made by "Skipping Rocks Labs". These fans ended up leaving plastic waste that adds up to more than 35,000 metric tons of CO₂.

If other events like world cups and Olympic games events could replace these single-use water bottles with edible water spheres, 71 tons of plastic waste could potentially be reduced [6]. A typical water bottle costs \$1.29. Accounting for the small size, one can say up to five edible water bottles – each holding around 10ml to 20ml – is equivalent to a 0.5L plastic water bottle.

When it is edible, it costs only \$1.00 to produce an equivalent edible sphere container to a plastic water bottle. Using edible water spheres could reduce costs by up to 33% [2].

Additionally, since edible water bottles are developed from seaweed, they do not compete with consumer crops like other plastic substitutes. Like in the case of some bioplastics that are developed using corn, which is another commonly grown natural resource for consumption.

Even though the edible water bottle offers many benefits, there are a few challenges that must be overcome before having these water parcels completely replacing plastic water bottles. The logistics of transportation could be an obstacle. Because even if the smaller spheres are bundled inside a larger one, the cells cannot be carried over long periods without being ruptured. In addition, users must adapt to the new way of drinking by consuming multiple spheres since each blob contains only one mouthful amount of water. Furthermore, while manufacturers can encase smaller

spheres in a larger one to transport bulky amounts of water, the blubs could be subject to many types of contaminations which is not the case while transporting the plastic water bottles [2].

Conclusion:

This paper has discussed the harmful effects of using plastic bottles on not only our carbon footprint but also on the ocean and the aquatic life. An alternative to plastic bottles was presented in this study which is the edible water blob. It would help to reduce plastic waste as well as the production cost compared to the plastic bottles.

The usage of edible water bottles can drastically decrease the carbon emission, reduce annual plastic waste, and reduce manufacturing costs.

Edible water bottles could greatly be in favor of major sports events around the world. during which, the use of edible water spheres would favor the accessibility to small amount of water, without worrying about the environmental harm caused by the plastic bottles.

There could be a great potential to replace plastic bottles with these edible water spheres after solving their transportation concern.

As, considering the spheres' versatility in the type of liquid that they can hold, as well as their minor flaws that can be fixed, these flexible and strong membrane-like packaging could soon not only replace plastic bottles but yet change the plastic packaging use.

References:

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[2]. Greene, Liz. "Edible Water Blobs: All You Ever Wanted To Know." Earth911, May 09, 2017. Accessed July 10, 2021.

<https://earth911.com/business-policy/edible-water-blobs/>

[3]. World Population Review. "Plastic Pollution By Country 2021." Accessed July 15, 2021.

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[4]. Lavit. "Million Plastic Bottles Per Minute – Scary Plastic Statistics." September 18, 2019. Accessed July 10, 2021.

<https://www.drinklavit.com/blog/plastic-isnt-green>

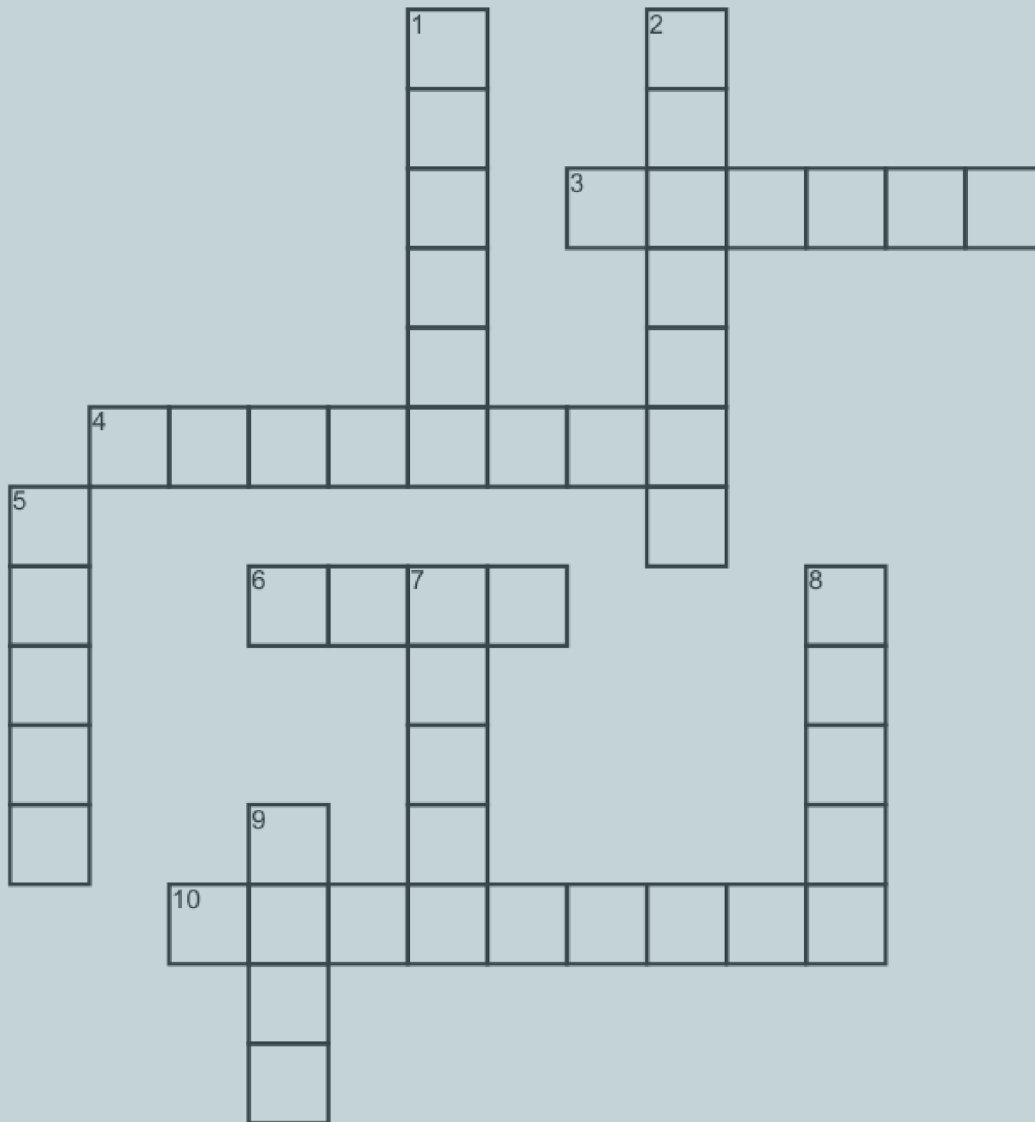
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<https://itschemicallydelicious.wordpress.com/2013/02/07/the-science-behind-spherification/>

[6]. Ettinger, Jill. "London Marathon Reduced 200,000 Plastic Bottles With Edible Water Pods." Livekindly. Accessed July 10, 2021.

<https://www.livekindly.co/london-marathon-edible-water-pods-plastic-bottles/>

Crossword



Across

3. The unit of force
4. The force that opposes motion. It starts with an 'f'.
6. _____ is the amount of matter in an object.
10. We measure volume using a _____ cylinder

Down

1. The force that acts on an object due to gravity is called _____
2. Something made up of the same kind of atoms is called an _____
5. A push or pull
7. The three states of matter are gas, liquid and _____.
8. A unit of mass.
9. Another word for air resistance.

WORD SEARCH

T U D M M L W F U V W Y S V W I X
R W V H Y P T J Z L F R O C E Z P
D M A T T E R I F E W H U B V A O
W D R N W T C N O G Y P N J T W H
T L O P G Z P C R K G I D H F I E
L K W O M Z S L C I A Q H W N N A
E X H T Q M J I E N M L W E X E T
V P E E J K M N N E E I Q D H R J
E L E N L B I E H T G Q C G D T O
R A L T P U S D E I R U X E L I W
V S A I P T O P Y C A I D C A A B
P M N A N L L L I O V D D B Z O M
U A D L D S I A T P I P X Z W H F
L V A I T C D N O O T P V P O E M
L J X S V R O E W W Y G A S R R M
E R L Y J E I X D E N E G X K T Q
Y X E H R W N V W R D I N M Z H Z

potential

kinetic

matter

plasma

gas

liquid

solid

power

work

force

gravity

heat

sound

inertia

wedge

pulley

inclined plane

Screw

Wheel and axle

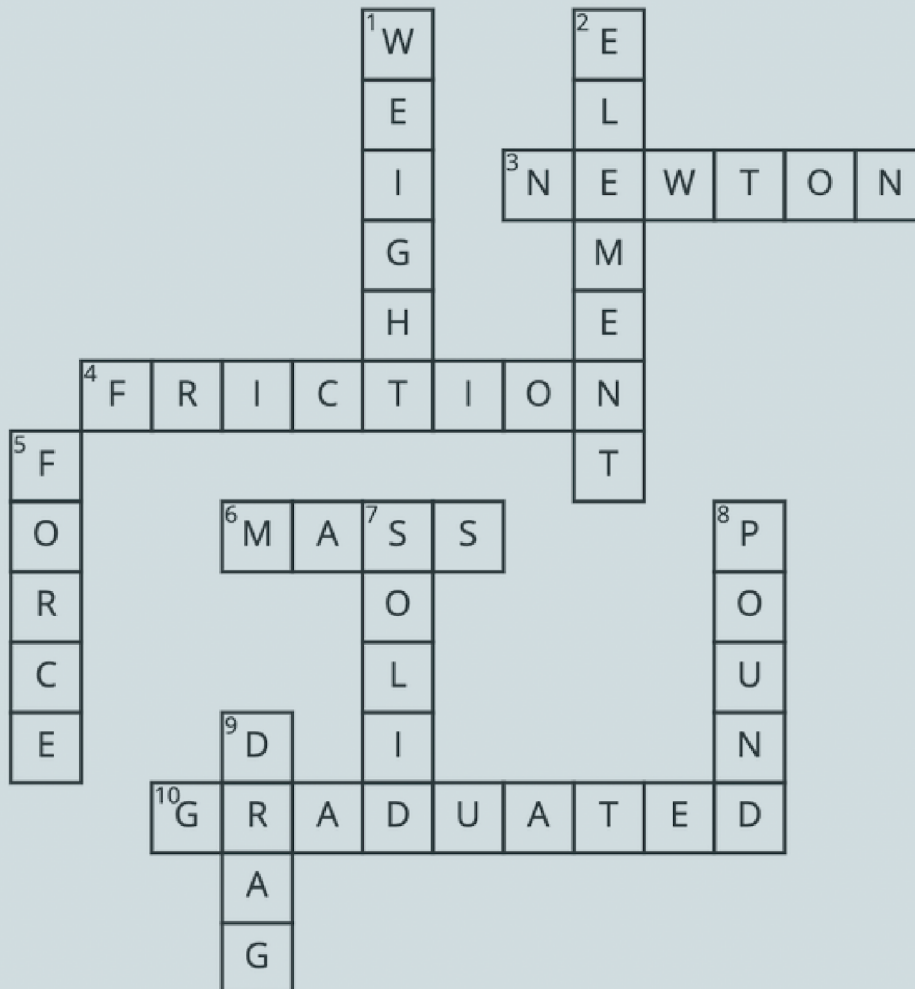
lever

ANSWERS AT THE BACK

RIDDLES

1. Lots of people have heard it, but no one has seen it. It will not speak back unless spoken to. What is it?
2. You can't see me, I can't be touched, you can't feel me - but I cook your lunch. What am I?
3. What is the center of gravity?
4. If you give it food, it'll live - if you give it water, it will die. What is it?
5. I touch your face. I am in your words. I am a lack of space and beloved by birds. What am I?
6. What chemical doesn't like to follow?
7. Which two elements heal?

Crossword Answers



Across

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1. The force that acts on an object due to gravity is called _____
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8. A unit of mass.
9. Another word for air resistance.

WORD SEARCH

ANSWERS

T U D M M L W F U V W Y S V W I X
R W V H Y P T J Z L F R O C E Z P
D M A T T E R I F E W H U B V A O
W D R N W T C N O G Y P N J T W H
T L O P G Z P C R K G I D H F I E
L K W O M Z S L C I A Q H W N N A
E X H T Q M J I E N M L W E X E T
V P E E J K M N N E E I Q D H R J
E L E N L B I E H T G Q C G D T O
R A L T P U S D E I R U X E L I W
V S A I P T O P Y C A I D C A A B
P M N A N L L I O V D D B Z O M
U A D L D S I A T P I P X Z W H F
L V A I T C D N O O T P V P O E M
L J X S V R O E W W Y G A S R R M
E R L Y J E I X D E N E G X K T Q
Y X E H R W N V W R D I N M Z H Z

inclined plane
gravity
liquid
force
lever

Wheel and axle
inertia
pulley
sound
work

potential
matter
solid
wedge
heat

kinetic
plasma
power
Screw
gas

RIDDLE

ANSWERS

1. An echo
2. A microwave particle
3. The letter "V"
4. Fire
5. Air
6. Lead
7. Helium and Aluminium (He and Al)

Cool Things to Check Out

COMPETITIONS:

- [HTTPS://WWW.IMMERSE.EDUCATION/ESSAY-COMPETITION/#SCROLL2](https://www.immerse.education/essay-competition/#scroll2)

WEBSITES:

- [HTTPS://WWW.LIVEKINDLY.CO/LONDON-MARATHON-EDIBLE-WATER-PODS-PLASTIC-BOTTLES/](https://www.livekindly.co/london-marathon-edible-water-pods-plastic-bottles/)

COURSES:

- [HTTPS://WWW.COURSERA.ORG/LEARN/CHEMISTRY-1](https://www.coursera.org/learn/chemistry-1)
- [HTTPS://WWW.COURSERA.ORG/LEARN/FUTURE-OF-ENERGY](https://www.coursera.org/learn/future-of-energy)