



Smithsonian

Underwater Training



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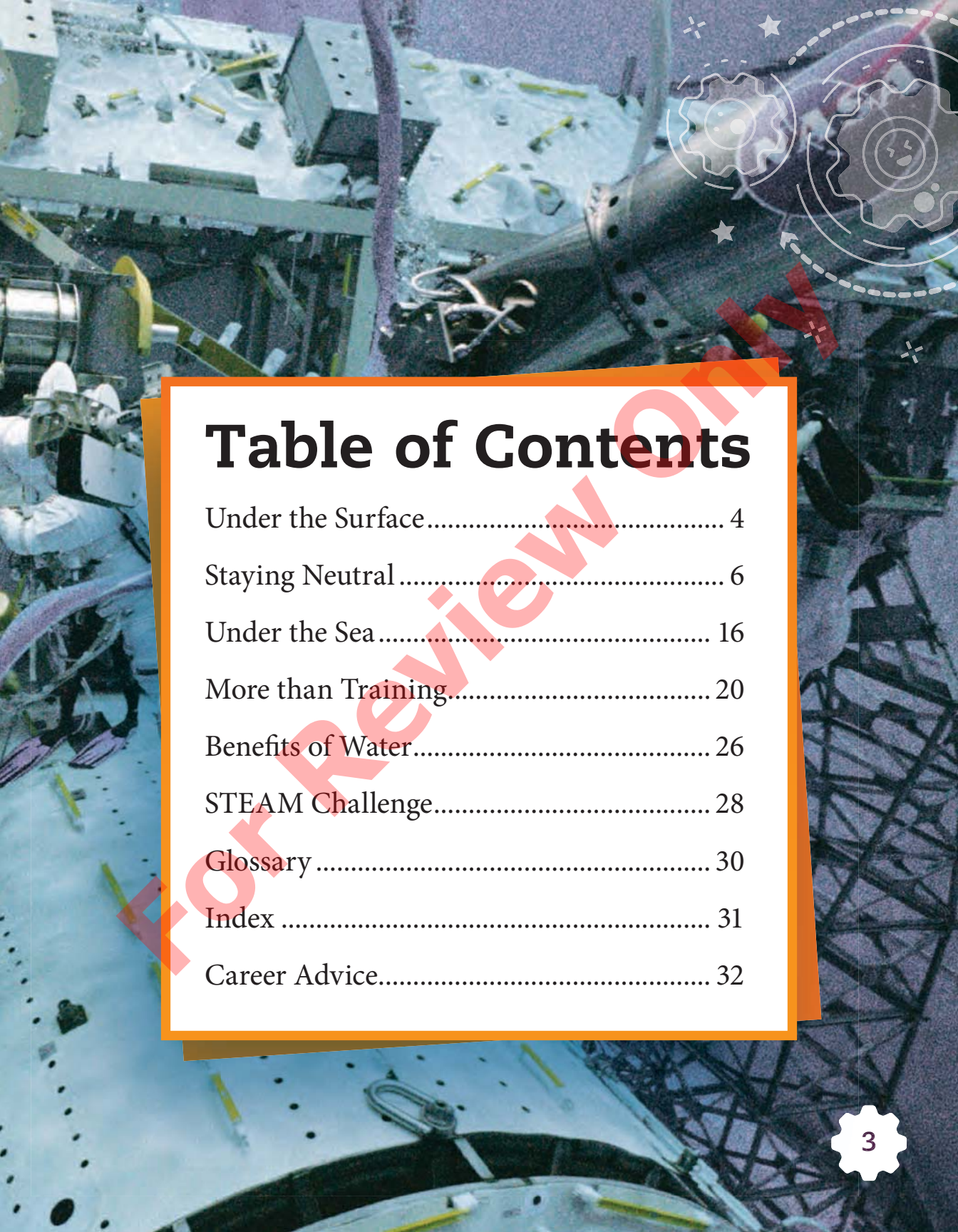


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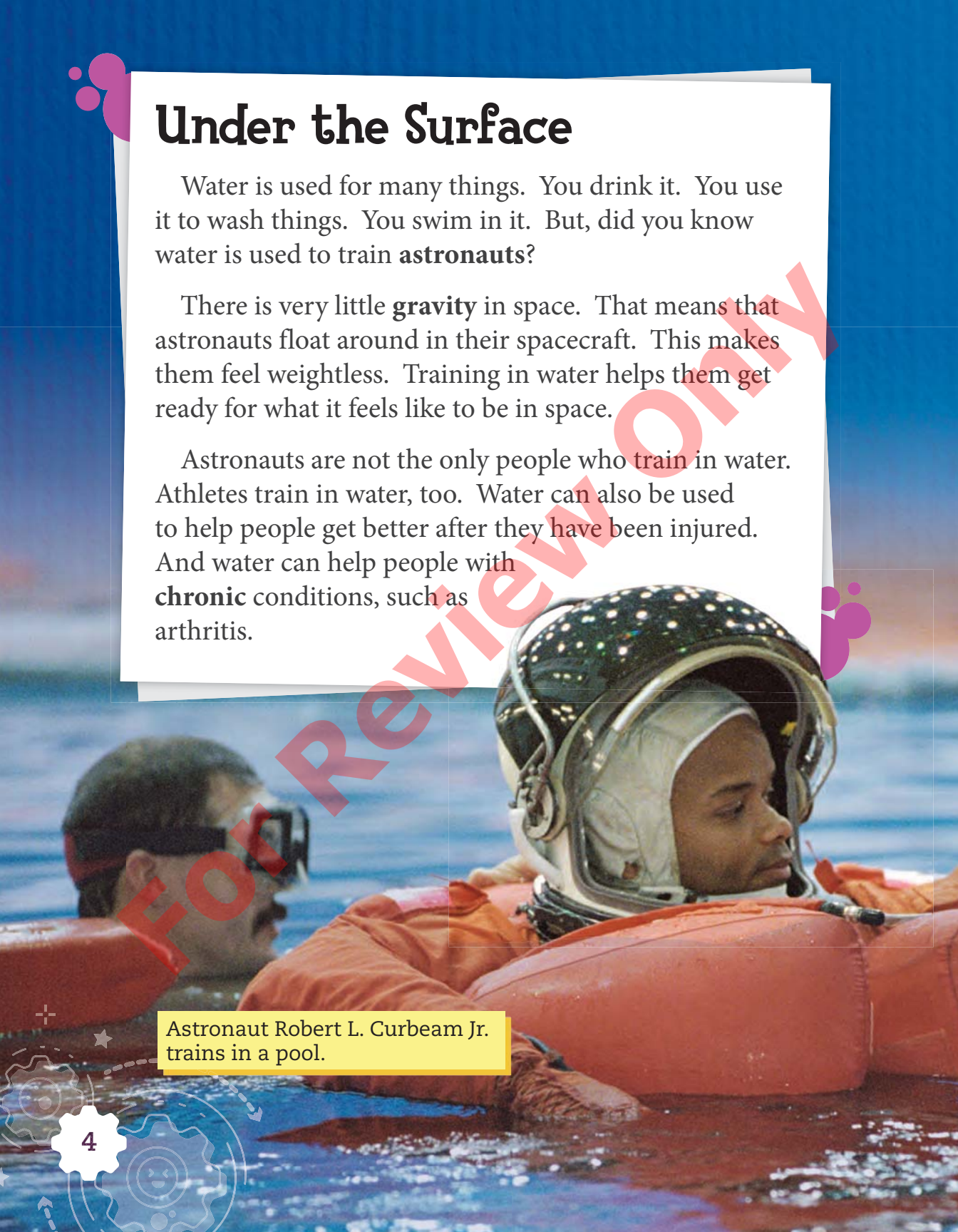
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Under the Surface

Water is used for many things. You drink it. You use it to wash things. You swim in it. But, did you know water is used to train **astronauts**?

There is very little **gravity** in space. That means that astronauts float around in their spacecraft. This makes them feel weightless. Training in water helps them get ready for what it feels like to be in space.

Astronauts are not the only people who train in water. Athletes train in water, too. Water can also be used to help people get better after they have been injured. And water can help people with **chronic** conditions, such as arthritis.

A photograph of astronaut Robert L. Curbeam Jr. floating in a pool. He is wearing an orange flight suit and a black helmet with a clear visor. He is looking down and to the right. In the background, another person is partially visible, also in the water. The water is blue and slightly rippled.

Astronaut Robert L. Curbeam Jr. trains in a pool.



An athlete swims in a pool.



These women exercise with weights in a pool.

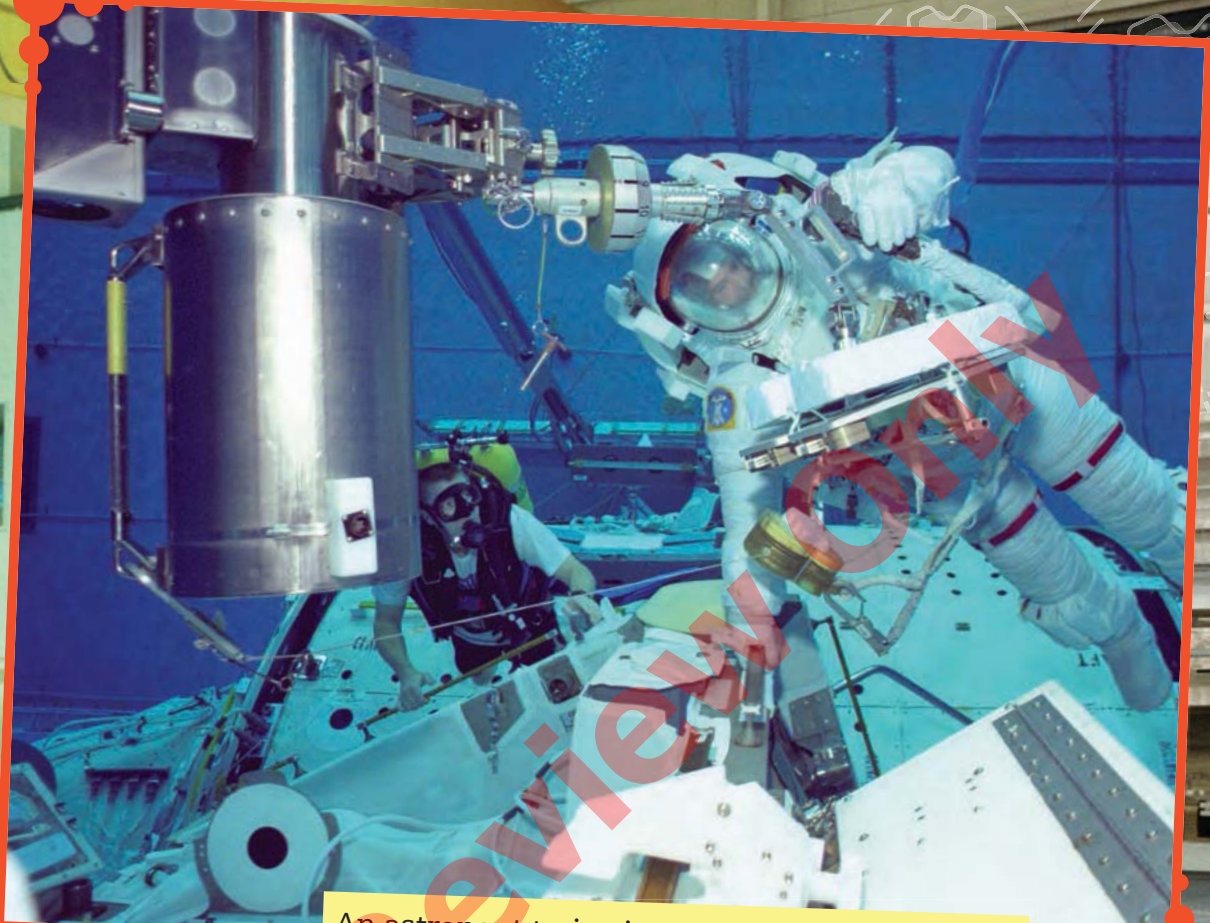
Staying Neutral

You may have noticed that objects that are heavy on land seem lighter when they are in the water. This is because they are more **buoyant** in water than they are on land. That makes some things that are hard to do on land much easier in water. In the pool, you can lift your friends with ease. You can even float!

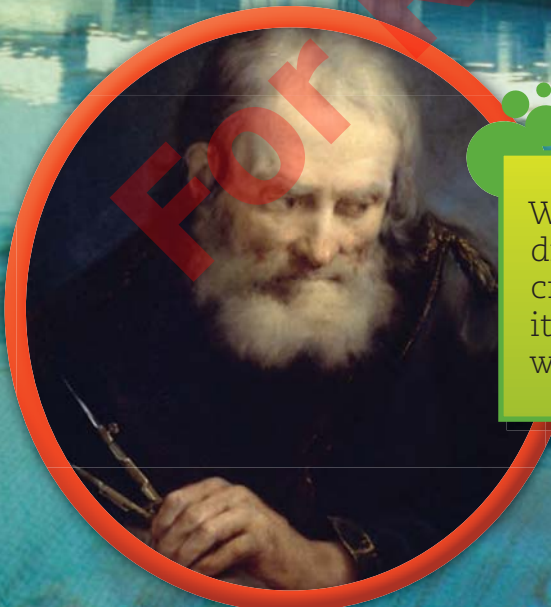
The feeling you have when you are in water is almost what it feels like to be in space. In fact, some astronauts train for space in water. They train in **labs** that have large pools. While in the pools, astronauts wear weights so that they don't float to the top or sink to the bottom. This is called *neutral buoyancy* (BOY-uhn-see).



NASA's Neutral Buoyancy Lab



An astronaut trains in a neutral buoyancy pool.

A circular inset image showing a portrait of Archimedes, an ancient Greek mathematician and inventor. He is depicted with a long white beard and hair, wearing a dark garment. He is holding a pair of compasses in his hands. The image is framed with a red border and decorative elements like stars and dashed lines in the top right corner.

When Archimedes (ahr-kuh-MEE-deez) discovered buoyancy, he is said to have cried, "Eureka!" It means "I have found it." It is now a well-known phrase when someone figures something out.

Train Around the World

There are neutral buoyancy pools all over the world. There is one in Russia. There is also one in Germany. Chinese astronauts practice in a pool in Beijing.

In the United States, there is a pool in Houston, Texas. It was built in 1995. It is part of the Neutral Buoyancy Lab. Many things are placed in the pool to help astronauts train. Even space stations have been put in the pool! When an entire station does not fit in the pool, it is split into pieces. A big crane is used to put pieces in the pool.



Astronaut Michael Barratt trains for a space walk in a pool in Russia.



neutral
buoyancy



float



sink

SCIENCE

Density

To understand how underwater training works, you need to understand density. Density is the amount of **matter** in an object compared to how big it is. Things that are less dense than water will float (see B above). Objects that are more dense than water will sink (see C above). When an object has the same density as water, it will suspend in the water (see A above). It will not sink or float. This is called *neutral buoyancy*. It makes you feel almost weightless.



STEAM CHALLENGE

Define the Problem

An important part of astronaut training happens right here on Earth! Scientists have asked you to make a neutrally buoyant underwater lab. Can you change an object to make it neutrally buoyant?



Constraints: You can only use three types of materials to make the object.



Criteria: The object must stay neutrally buoyant in a water tank for 30 seconds.





Research and Brainstorm

How does training in water prepare astronauts for space? What does it mean to be neutrally buoyant? What could you add to an object that floats to make it sink?



Design and Build

Observe the materials. Then, sketch your design of the object. What purpose will each part serve? What materials will work best? Build the model.



Test and Improve

Test your object in the water tank. Did it work? How can you improve it? Modify your design by adding to it or removing from it. Try it again.



Reflect and Share

Do you think the object would be neutrally buoyant in other types of liquid? What about this challenge was most difficult? How did you overcome it?

